

JANUARY 1945 — FIFTY-FIRST YEAR

# MACHINERY



Aircraft operation at one of the plants of the Lockheed Aircraft Corp.



ARMSTRONG

173  
184  
238

137

140

148

156

162

170

174

177

178

182

196

199

200

206

236

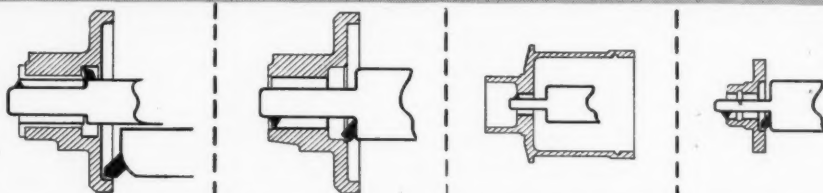
236

189

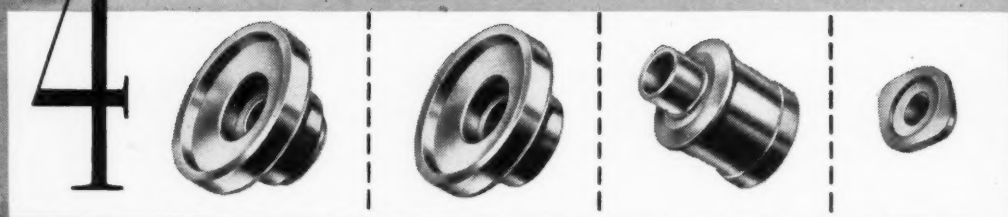
193

try

# 4 OPERATIONS



# ON 4 PARTS SIMULTANEOUSLY!



## *A Single* HEALD BORE-MATIC Does It!

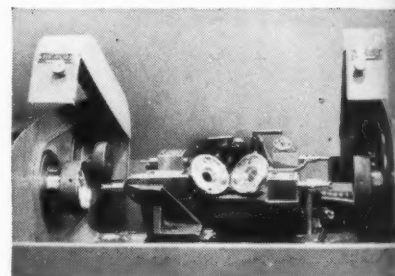
What can *boring* on Bore-Matics do for you? In short, it will enable you to hold closer tolerances, obtain a better finish and step up production rates. And these results can be obtained on *all* types of operations — on *all* types of work.

The basic adaptability of Heald Bore-Matic design makes it possible, for example, to do boring, turning, facing, chamfering, grooving and fly-cutting. Straight and taper surfaces can be machined as well as curves and irregu-

lar shapes. All these operations can be performed singly, simultaneously, progressively, or in combination. In addition to final finishing — where the surface obtained often reduces or even eliminates lapping and honing — Bore-Matics are applicable for roughing and semi-finishing.

To help in planning faster, lower-cost production, better post-war products ... get the Bore-Matic story *today*.

THE HEALD MACHINE CO.  
WORCESTER 6, MASS.



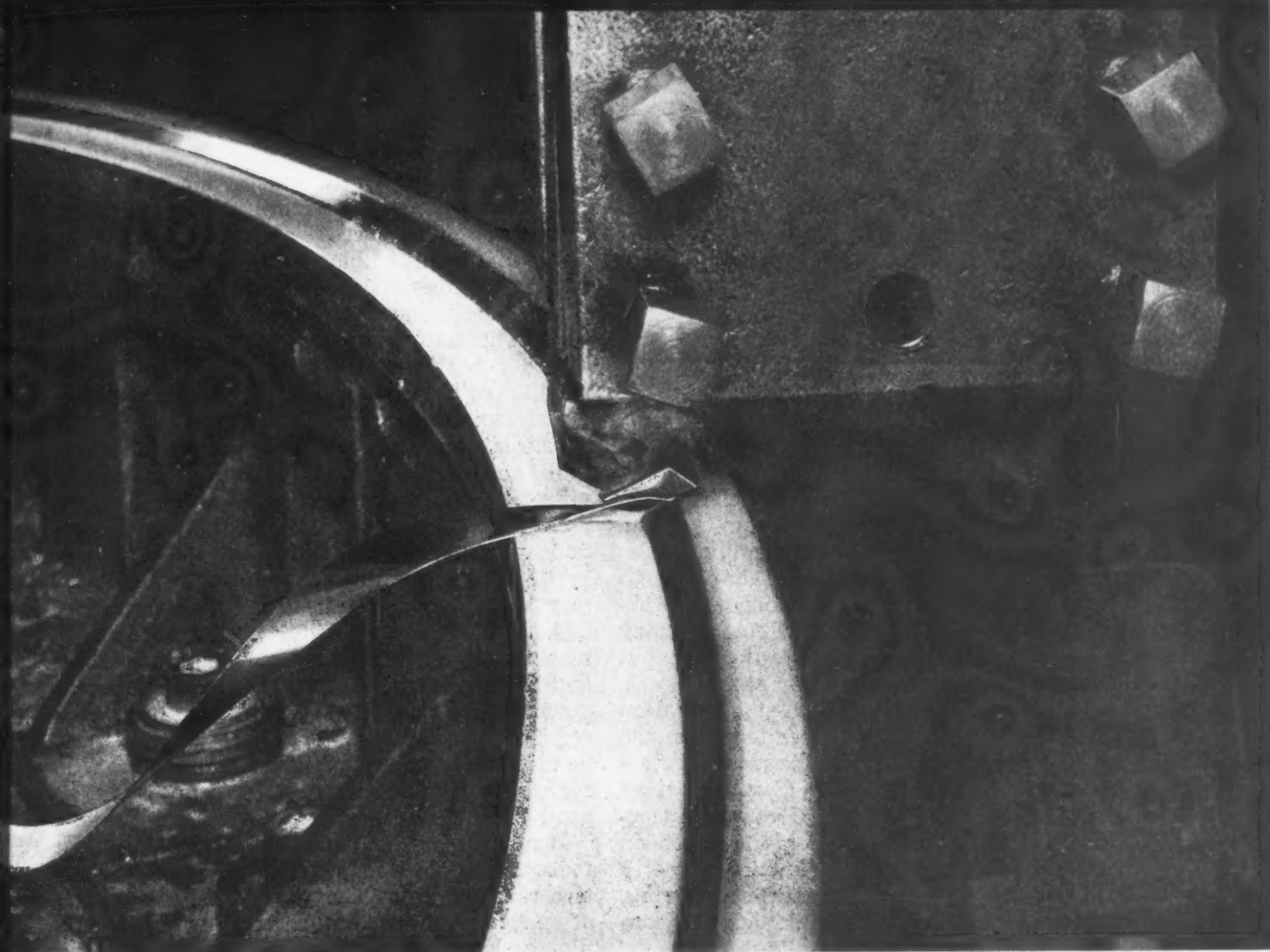
This Heald Bore-Matic is arranged to precision finish four different parts in the same cycle. Adapter Assembly, Housing, Adapter and Coupling are held in rotating fixtures and several finishing operations performed on each piece—including facing, boring, counterboring and chamfering.

# HEALD *Bore-Matics*

THE MOST VERSATILE MACHINE TOOL

**Internal and Surface Grinding Machines • Bore-Matic Precision Finishing Machines**

MACHINERY, January, 1945



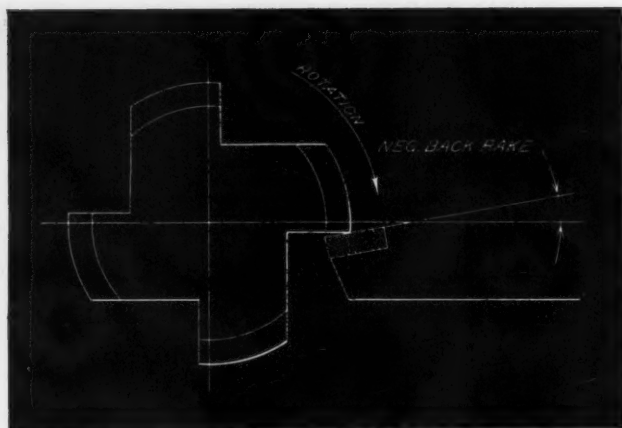
## Negative-Rake Turning and Boring

By GEORGE M. JALMA, Jr., Engineering Department  
Northern Ordnance Incorporated, Minneapolis, Minn.

**C**EMENTED-CARBIDE tools have been widely employed for some years in production machining by the Northern Pump Co. and its subsidiary, Northern Ordnance Incorporated. A survey conducted in 1942 revealed that on 36 vertical turret lathes, 48 vertical boring mills, 83 horizontal turret lathes, and 45 Bore-Matics, the amount of machining done with

carbide tools came to 80, 90, 90, and 99 per cent, respectively.

The early use of carbide tools was primarily in the machining of cast iron and non-ferrous metals. However, the subsequent development of titanium and tantalum tungsten carbides inaugurated a new field for carbide tools—the machining of steel. The advent of war brought



**Fig. 1. Diagram Showing that with Negative-rake Tools the Cut is Started in Back of the Point**

new production problems. The machining of National Emergency steels; the "jump" cutting of armor plate, high nickel and chromium steels; and the interrupted machining of hard tough weldments and forgings were among the problems that had to be dealt with. Of course, many such jobs were encountered before the war, but without the wartime demands for speed.

Radical changes in the design and operation of carbide cutting tools have resulted from the wartime requirements. One of the most spectacular of these changes was the development of negative-rake tools. Northern Ordnance Incorporated has conducted considerable research on negative-rake tools. This article will deal with tools of that type employed in turning, boring, and planing operations only, although the concern also uses negative-rake milling cutters.

In considering the application of negative-rake tools, it should be remembered that such tools do not constitute a "cure all" for machining problems. The tools to be described were designed for a particular operation on a specific product to be machined on an individual machine. The individual characteristics of the machines and operators must, most emphatically, be considered in planning to adopt negative-rake tools. The success of the particular tool angles and radii employed depends a great deal on the machine that is to use the tool. Time after time, it has been found that while a job runs satisfactorily on one machine, if this job, together with the tools, is moved to another machine of the same make and model, the results may be unsatisfactory. This is particularly true of the larger machines, such as vertical boring mills and vertical turret lathes. One machine might be able to withstand more or less tool pressure than another; another may have more or less backlash; and, as in the case of a large vertical boring mill, either or both tool rams may be off location—ahead or behind center.

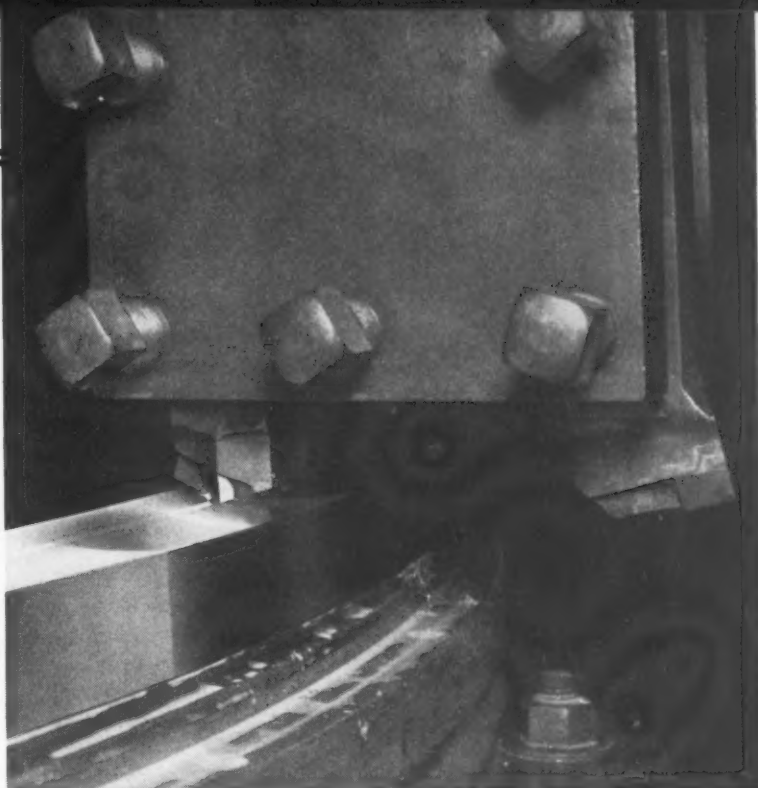
A most important factor with regard to the machine is one that has been emphasized over and over by carbide tool men—available horsepower. Since negative-rake tools in most cases require more horsepower, a thorough check must be made as to power available at the tool. With regard to the operator, much depends on his good judgment and willingness to cooperate.

It might be well to add that whenever carbide tools are to be used, whether positive or negative rake angles are employed, proper selection of carbide grades and correct grinding techniques should be observed. This information is



**Fig. 2. Facing Operation on a Large Roller Path for a Gun Mount, which is Performed with Tools having a Negative Back Rake of 45 Degrees and a Positive Side Rake of 15 Degrees**

**Fig. 3. (Right) Close-up View of a Finishing Operation on a Roller Path, which is Performed with a Carbide-tipped Tool having a Neutral Back Rake and a Negative Side Rake of 13.5 Degrees**



**Fig. 4. (Below) Armor-plate Gun-port Shield Assembly is Turned Successfully by the Use of a Tool having Negative Back and Side Rake. The Cutting Speed is Approximately 220 Feet a Minute**

readily available from the manufacturers of carbide tools.

Negative-rake carbide turning and boring tools possess desirable advantages for the following reasons:

1. Since cemented carbide has an extremely low tensile strength but tremendous compressive strength, tool designs should be based on compression wherever the tip is endangered, as on interrupted cuts, cutting through sand or scale, or similar conditions.

2. On negative-rake tools making interrupted cuts, the nose is usually below or behind center, depending upon whether it is used in a horizontal or vertical machine (see Fig. 1), thereby strengthening the tool, since this makes it possible to reduce the primary clearance angles.

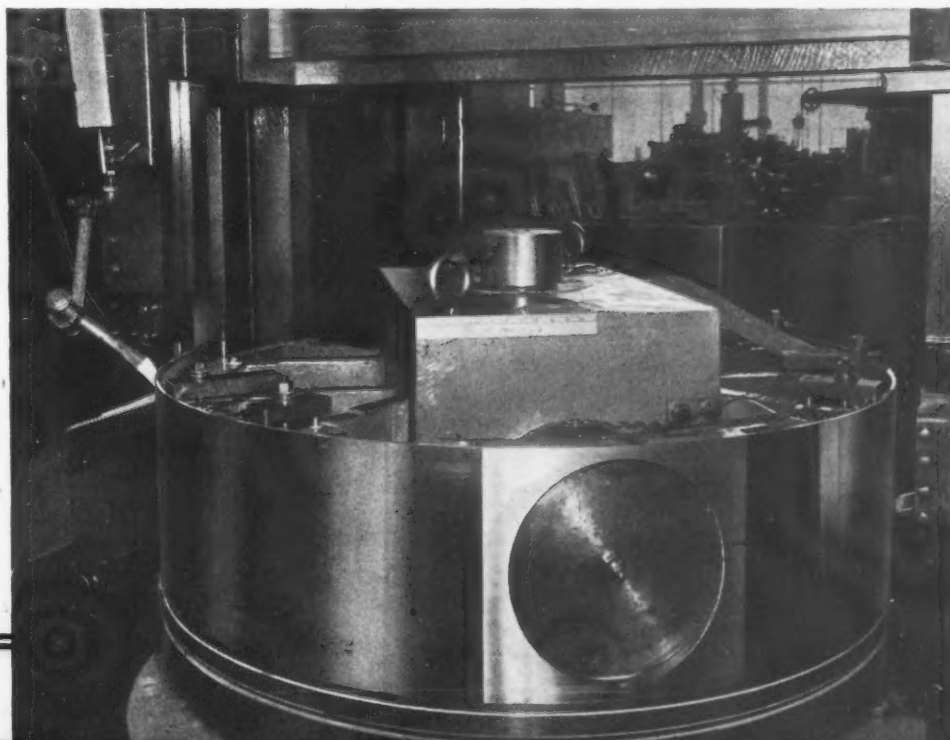
3. Should any backlash be present in the ma-

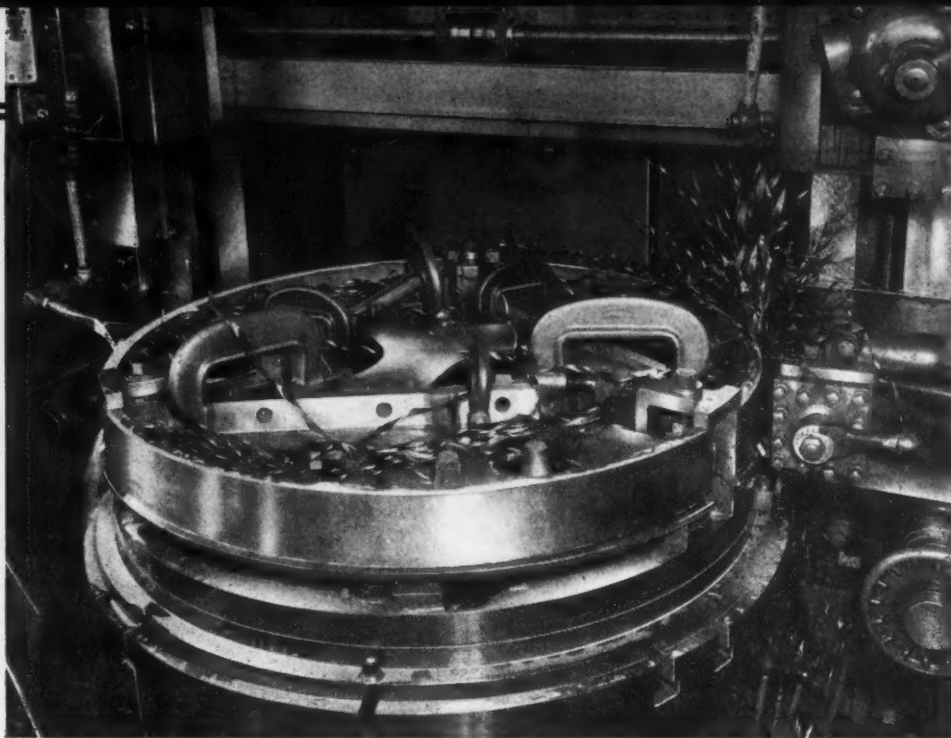
chine, the back pressure created by the application of a negative-rake tool will tend to protect the tool nose.

4. With negative-rake tools, it is possible to divert most of the heat of machining from the tool or work into the chip.

5. Negative rakes give nose angles of more than 90 degrees, again strengthening the tool.

6. Tools designed with proper negative rake angles may, in many instances, remove the need for costly chip-breakers. Much extra time is often required to properly grind and regrind chip-breakers in a carbide tool, and should the tip become chipped or cratered, much grinding is necessary to reshape the tool. On cast metals of comparatively low tensile strength, a good negative-rake tool will break the chips in a satisfactory manner. In machining metals of high





*Fig. 5. Negative-rake Cutters have been Found Especially Suitable for Machining Steel Castings and Taking Interrupted Cuts*

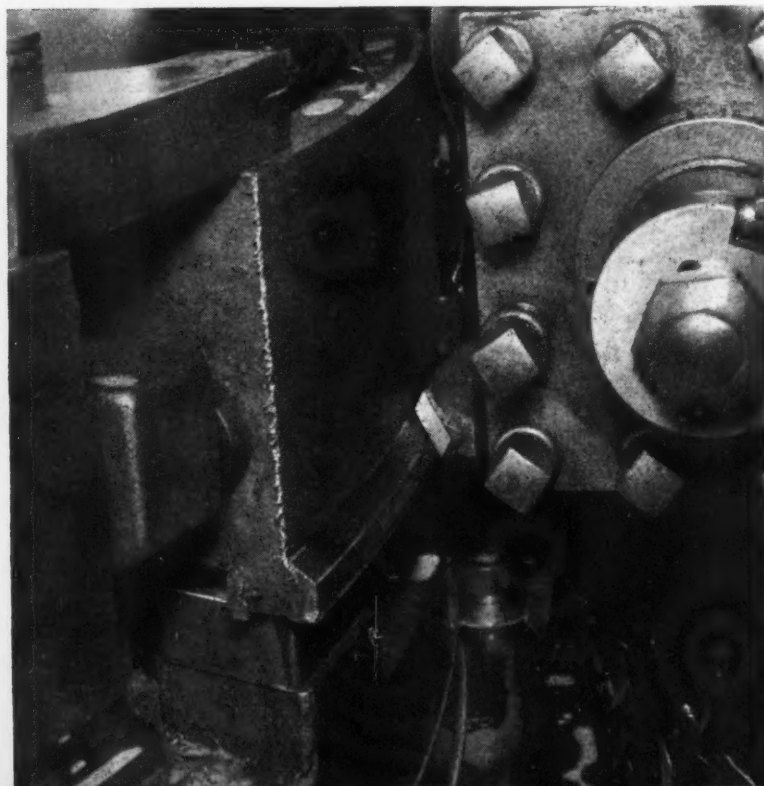
tensile strength, and this is practical only on large boring mills, a continuous chip may be produced by hooking the start of the chip into the center of the machine table where it will wind itself until the cut is completed. There are, however, cases where a chip-breaker is necessary, as in the machining of ductile metals on an engine or turret lathe. In such operations a continuous chip would be out of the question.

7. On large vertical boring mill work it is often difficult to obtain a fine feed. A coarse feed gives a "phonograph record" finish unless a generous radius is employed. It has been proved by experience that any nose radius is detrimental

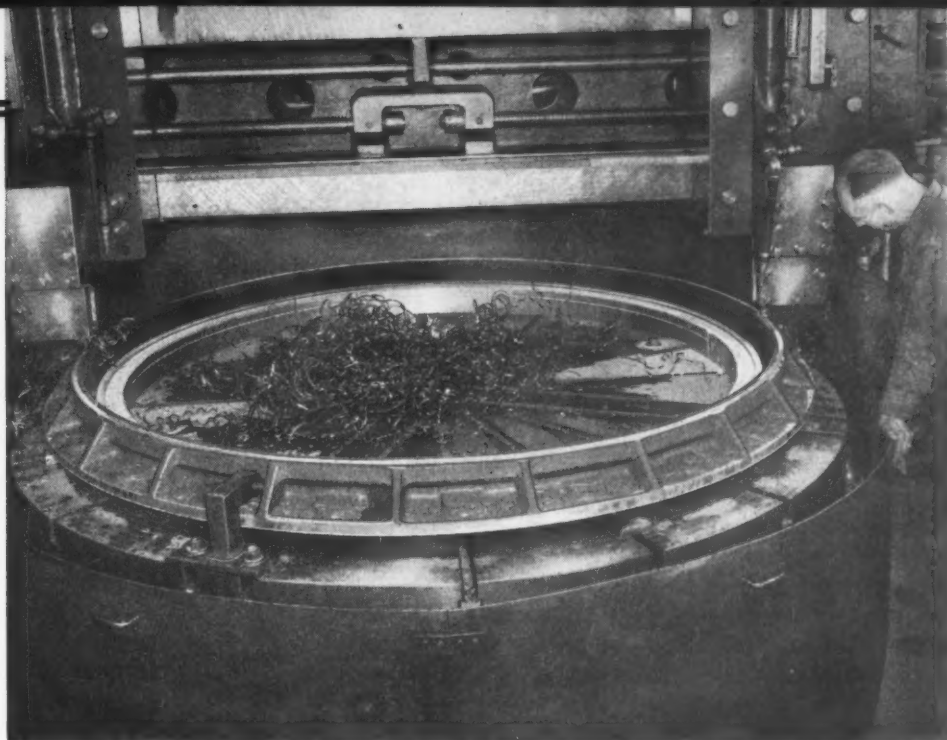
to the successful working of a carbide tool. Therefore, it would seem that nose radii should be held to an absolute minimum, except, of course, where it is necessary to machine a fillet. It has been proved that a properly designed negative-rake tool will remove "feed" grooves, thus resulting in a smoother finish.

8. As pointed out by R. G. Hummer and Ray Wells, of the Defiance Machine Works, Inc., at a meeting of the American Society of Mechanical Engineers, "With positive-rake cutters, chips of ductile metals seem to be removed by a varying degree of shear, tear, and flow. The material immediately ahead of the tool's point

is trapped and compressed against the face of the tool until it is subsequently sheared or torn away by the forces reacting at right angles to the face of the tool. When a negative-rake cutter is used, this compressive force is much greater, since the forces at right angles to the top rake of the tool are not of a shearing action. The actual shearing of the metal is a result of the side rake, whether it be positive or negative. In substance,



*Fig. 6. Close-up View of the Cutter Employed in the Operation Shown in Fig. 5, which has a Negative Back Rake of 45 Degrees and a Positive Side Rake of 15 Degrees*



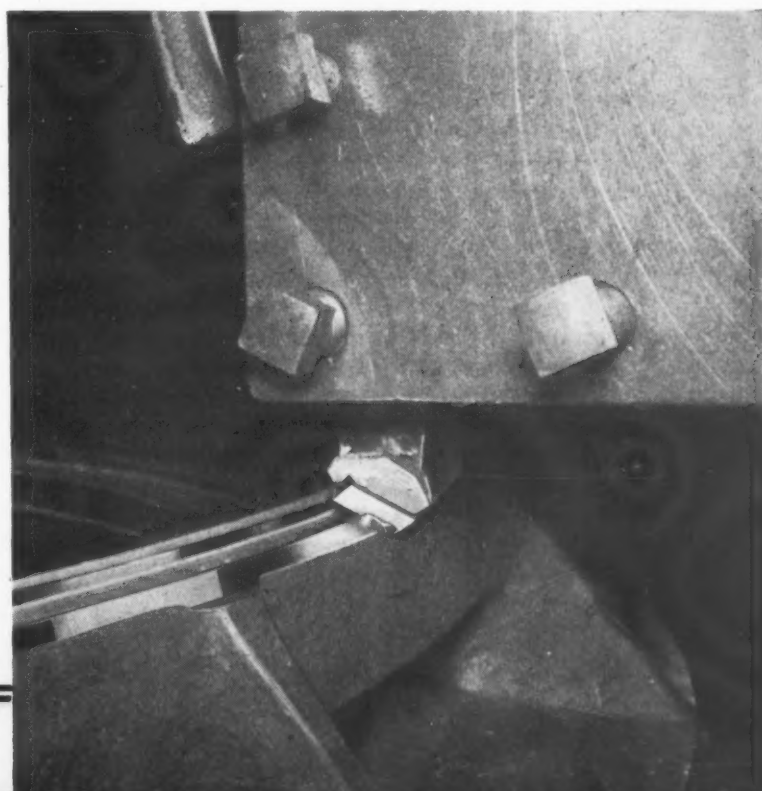
**Fig. 7. Negative-rake Facing Cutters are Especially Advantageous for Machining Steel Castings Containing Foundry Sand**

the action is, therefore, a compression of the metal downward, tending to close the pores of the metal, and then a sideward shearing of the compressed chip. This, we believe, is one of the reasons exceptionally smooth finishes are obtained . . ."

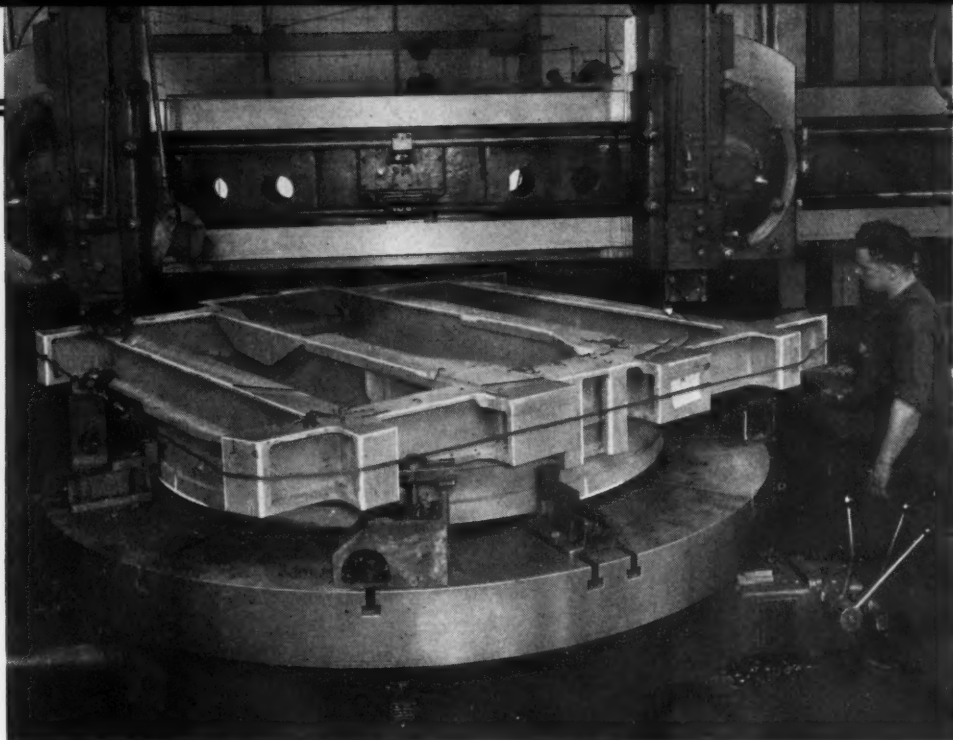
The most common types of negative-rake turning and boring tools used at Northern Ordnance Incorporated are shown in Figs. 15 and 21. Tools similar to that shown in Fig. 15 are intended primarily for taking heavy interrupted cuts when sand or scale offers obstacles to the working of a carbide tool. Tools employing negative lands, as shown in Fig. 21, are commonly referred to at Northern Ordnance Incorporated as "picture-frame" tools. They are used for more or less general-purpose operations necessitating the application of negative rake angles. These tools are comparatively easy to grind, but are seldom used on cuts exceeding 1/8 inch in depth.

The heading illustration shows a typical rough-facing cut being taken on a vertical boring mill with a tool having a negative back

rake of 45 degrees and a positive side rake of 15 degrees. This tool is similar to the one shown in Fig. 15 except that it is of right-hand style, whereas the tool in Fig. 15 is of the left-hand type. The cut is about 3/8 inch deep, and is taken at a speed of approximately 210 feet per minute. The feed is 0.021 inch per work revolution. Obviously, with a tool of this design, the cut is taken to the full depth before the bottom cutting point comes into action. The work is a large roller path for a 5-inch gun mount, and is made of tough alloy steel that has been heat-treated to a hardness of 45 to 55 scleroscope. The chief reason for the use of a 45-



**Fig. 8. Close-up View of One of the Cutters Used in the Operation Shown in Fig. 7, the Continuous Chip having Broken off when the Machine was Stopped for Taking the Photograph**



**Fig. 9. The Increased Strength of the Carbide Tip on Negative-rake Tools is of Advantage in Machining Weldments where the Cut is Interrupted Many Times**

degree negative-rake cutter in this operation is the scaly condition of the work.

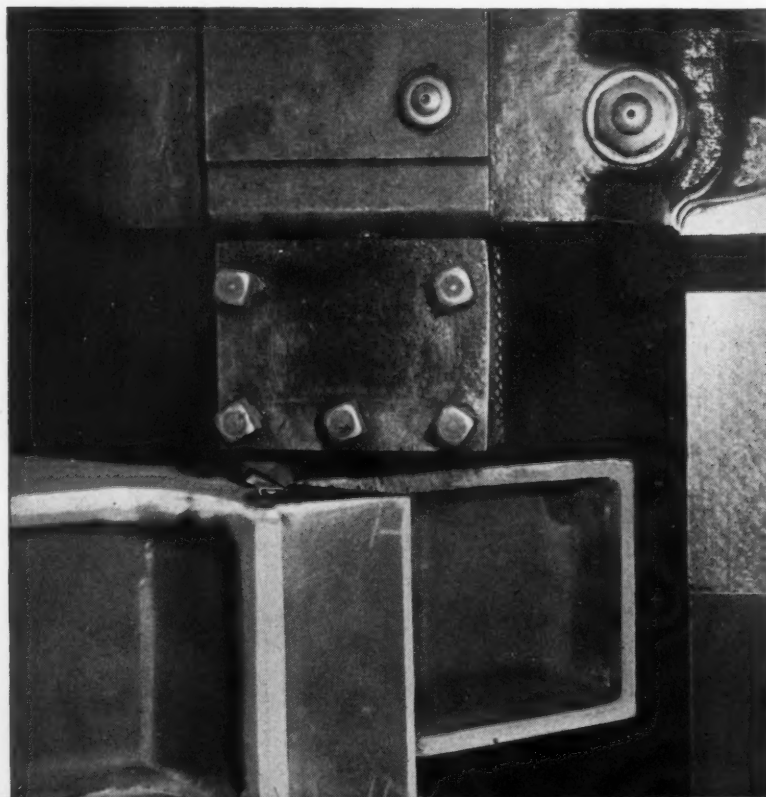
Three of these roller paths, which are 87.125 inches in diameter, are faced with a single sharpening of the cutter. The surface being faced is approximately 2 inches wide. After finishing cuts have been taken, the top and bottom surfaces of the rings must be parallel within 0.001 inch. The specified thickness is 0.875 inch within plus nothing minus 0.002 inch. Both sides are faced in the same manner.

A general view of the roughing operation is presented in Fig. 2, which shows that two cut-

ters on opposite sides of the boring mill are employed simultaneously. At the beginning of the operation, the chips from both cutters are twisted around each other in the center of the table by the operator, using a long hook. From then on, the continuous chips are connected and remain in a ball on the table. This removes all danger of injury to workmen from flying chips, and the entire ball can be removed at one time with a fork when the operation is complete.

A finish-facing cut is being taken in Fig. 3 on a roller path ring of the same type as that seen in Fig. 2 but of considerably greater thickness.

In this operation, the ring is held on a large-diameter magnetic chuck. The negative-rake cutter produces, in this case also, a continuous chip, which was broken off when the machine was stopped to facilitate taking the photograph. The finishing cut of 0.025 inch depth is taken at a speed of 260 feet per minute with a feed of 0.015 inch. This cutter has a neutral back rake and a negative side rake of 13.5 degrees. The end and side cutting



**Fig. 10. Close-up View of the Operation in Fig. 9 Taken with the Machine in Motion, the Cutting Speed at the Extreme Ends of the Weldment being About 640 Feet per Minute**



**Fig. 11. Negative-rake Tools are Employed in Turning Fillets and Straight Sides on Alloy-steel Gear Blanks in the Operation Here Illustrated**

edge angles are identical in this case, and the tool may be fed in either direction. A chamfering cut on both the inside and outside diameters is made possible by the lead angles of 20 degrees.

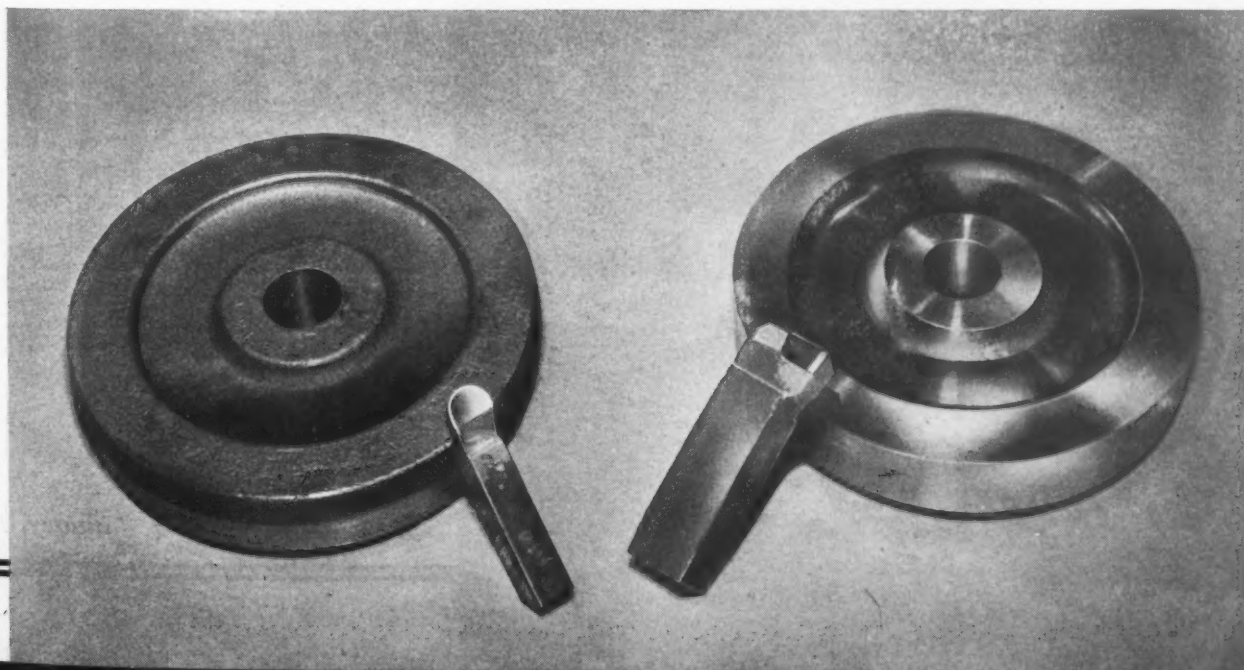
Shields of armor plate are successfully turned with regard to speed, finish, and dimensional accuracy by the use of a tool having a negative side rake of 45 degrees. This operation is illustrated in Fig. 4. It will be noted that interrupted cuts are involved, due to the fact that the shield does not comprise a full circle. Another point to be noted is the bore in the steel casting that separates the two parts of the shield.

A rough cut that just removes the high spots

on the tough alloy armor plate is followed by a finishing cut 0.070 inch deep. The speed is about 220 feet per minute, and the feeds in roughing and finishing are 0.025 inch and 0.015 inch, respectively.

A typical operation in which negative-rake cutters prove useful for machining interrupted cuts in steel castings where foundry sand may be present is shown in Fig. 5. Here elevating arc brackets are being turned three at a time. There is a gap of several inches between each casting. The over-all diameter of the three brackets, as mounted on the boring mill table, is 60 inches.

**Fig. 12. The Two Negative-rake Cutters Employed in the Operation Shown in Fig. 11, together with Rough and Finished Gear Blanks**



The roughing cut is 1/8 inch deep, except at the lower end of the castings, where metal is removed to a depth of 9/16 inch for a narrow width. The cut is taken at 290 surface feet per minute, the feed being 0.015 inch. The tool, shown in the close-up view in Fig. 6, has a negative back rake of 45 degrees and a positive side rake of 15 degrees. The light finishing cut, 0.005 inch deep, is taken with a standard high-speed steel cutter, because the brackets are hand-scraped in assembly, and the assembly men contend that a "carbide finish" makes hand-scraping difficult.

An application in which negative-rake tools facilitate the facing of steel castings is illustrated in Fig. 7. In this case, the work consists of a stand for a 5-inch 38-caliber single gun mount. Cuts 1/4 inch deep are taken in rough-facing by tools on opposite sides of the machine. The casting has an inside diameter of 90 3/8 inches, and is revolved at a speed of 11 R.P.M., giving a cutting speed exceeding 250 surface feet per minute. The feed is 0.025 inch. The same cutters are used in finishing, but with a 0.025-inch depth of cut and a 0.015-inch feed.

Three or four stands can generally be rough- and finish-faced for each sharpening of the tools. With proper honing before and between operations, the tool life may be extended to six or seven stands. These tools are of the type shown in Fig. 16, having a negative back rake of 45 degrees and a positive side rake of 17 degrees. Normally, after the webs are cut, a continuous chip is produced, but when the machine was stopped for the close-up view shown in Fig. 8, the chip was broken.

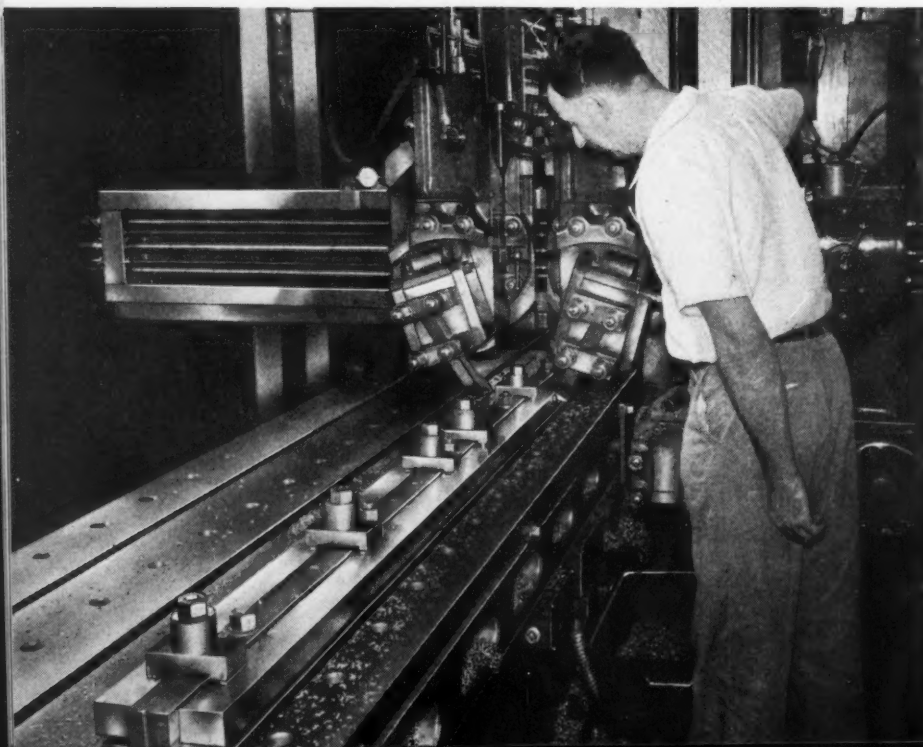
An operation that emphasizes the shock-

resisting qualities of negative-rake turning tools is illustrated in Figs. 9 and 10. These illustrations show 45-degree shear tools being employed for facing a large structural weldment. The cuts taken by the tools on the two tool-heads are constantly interrupted. One of the cutters takes a roughing cut 9/32 inch deep and the other a finishing cut 1/32 inch deep. The feed is 0.025 inch.

On this particular boring mill, the work is revolved at 17 R.P.M., and since the maximum width of the work is 12 feet, this means a cutting speed of about 640 surface feet per minute when the tools are working on the extreme edges of the weldment. The maximum cutting speed on this operation will vary approximately between 525 and 814 surface feet per minute, depending on the individual boring mill used. On the average, one cutter will machine an entire weldment without requiring servicing. There are, however, instances where two and sometimes three tools are necessary, as the alloy steel from which the weldment is fabricated varies considerably in physical properties.

Fig. 11 illustrates a turret lathe operation where negative-rake tools are being used in turning and facing gear blanks of SAE 4340 steel. At the time the photograph was taken, a radius cutter such as seen at the left in Fig. 12 was being employed for machining a fillet around the inside of the rim. A ribbon-like chip is produced while cutting with a feed of 0.008 inch and a speed of more than 300 surface feet per minute. The same tool is used for turning the fillet around the hub.

The tool is first ground to the required radius with standard clearances but neutral side and



*Fig. 13. Planing Operation in which Bronze Bearing Strips for Gun Slides are Finished to an Exceptionally Close Tolerance*

**Fig. 14. Close-up View of the Cutters Used in the Bearing-strip Planing Operation, which have a Negative Back Rake of 2 Degrees and a Neutral Side Rake**

back rakes. A 1/16-inch wide, 10-degree negative land is then ground across the top, following the contour of the radius. At the right in Fig. 12 is shown an offset facing tool that is also "beveled" to a negative rake, in this case for a width of 1/8 inch. This tool is used for taking facing cuts on the side of the gear. The tool is ground in a manner similar to the tool shown in Fig. 21.

Negative-rake tools have also proved of particular advantage in the operation shown in Figs. 13 and 14, which consists of planing bronze bearing strips for gun-mount slides. These strips are 79 1/4 inches long and must be 2 inches wide within a tolerance of plus 0.0005 inch minus nothing by 1.4375 inch thick within plus nothing minus 0.001 inch. The use of negative-rake tools in this operation eliminates the hand-scraping formerly necessary to obtain the required finish and accuracy. These planer tools have negative back rakes of 2 degrees and neutral side rakes. In roughing, the cut is 1/16 inch deep, and in finishing 0.003 inch deep. In both cases, the feed is 0.015 inch per stroke. The planer is operated at its maximum forward speed.

Fig. 15 shows a negative-rake tool commonly referred to as a shear tool. This tool has 25-degree end and side cutting edge angles, a 45-degree negative back rake, and a 15-degree positive side rake. About four or five years ago, this tool was developed for use on a horizontal turret lathe. The job called for an interrupted cut in the facing of a rammer spring. The spring consisted of a hard tough steel forging, and the specifications called for a very fine finish. The roughing cut was taken at 425 surface feet per minute with a feed of 0.0054 inch and a depth of cut of 0.375 inch. The finishing cut was taken at 550 feet per minute with a 0.0039-inch feed and a 0.062-inch depth of cut.

Today this tool and variations thereof are being used on engine lathes, vertical and horizontal turret lathes, and vertical boring mills. The shear tool in various combinations of rake and cutting edge angles can be purchased commercially, and is particularly useful for taking heavy interrupted cuts on scaly steel, weldments, and forgings.

The promiscuous use of negative-rake tools should be avoided since, in most cases, they re-



quire more horsepower and more care in grinding. In Fig. 16 is shown a tool used in semi-finishing and finishing roller-bearing steel. This tool has a neutral back rake and a positive side rake of 4 degrees. The particular parts call for a light, scale-free, continuous cut, and it is only when the hardness is too great for the standard tool that the negative-rake tool illustrated in Fig. 17 is employed. This tool is one example of a "picture-frame" tool, having negative lands ground parallel to both the side cutting edge and the end cutting edge. The negative back rake and negative side rake are both 5 degrees. In this operation, the feed is 0.010 inch, the speed about 210 surface feet per minute, and the depth of cut up to 0.020 inch.

A roughing tool used on a vertical turret lathe for machining a hammer-forged SAE X1020 steel base stand is shown in Fig. 18. The cutting speed is approximately 550 surface feet per minute, the depth of cut about 0.250 inch, and the feed 0.015 inch. This tool is first ground with a 10-degree negative back rake and a 3-degree positive side rake. Along the side cutting edge on the top of the tool, a 1/8-inch 10-degree negative land is then ground. Following this, a 10-degree negative land, 1/8 inch wide, is ground along the end cutting edge.

Although the tools shown in Figs. 19 and 20 are not negative-rake tools, they may be used, briefly, to illustrate at least one instance where the knowledge of the capabilities of the machine is important to the successful operation of a tool. The turning tool in Fig. 19 was doing a fine job of semi-finishing an 8-foot diameter bearing steel ring on a vertical boring mill. Pro-

TURNING, BORING, AND FACING TOOL (L.H.)

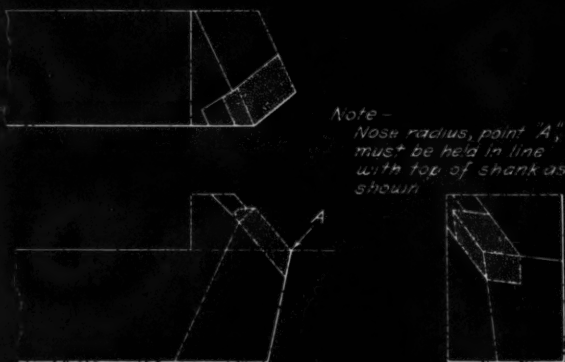


FIG. 15

FACING TOOL FOR ROLLER BEARING STEEL (L.H.)

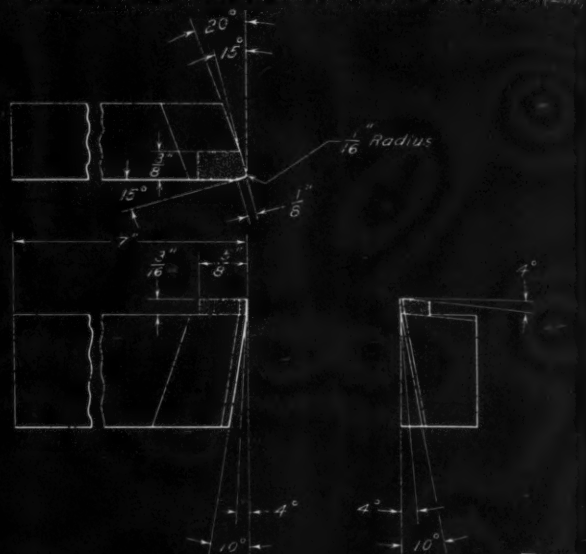


FIG. 16

OFFSET TURNING TOOL (L.H.)

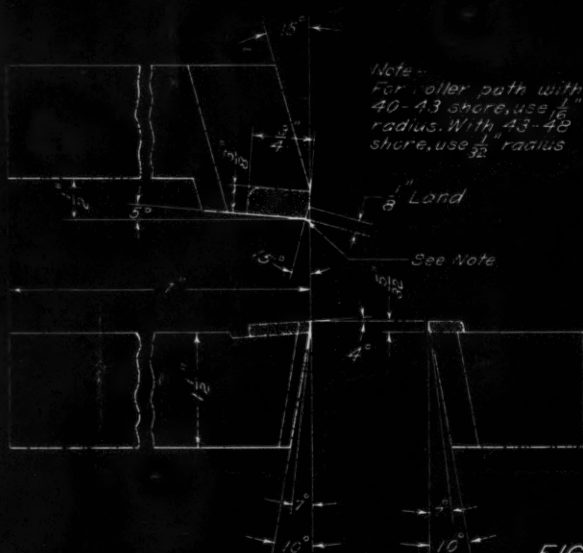


FIG. 19

OFFSET TURNING TOOL (L.H.)

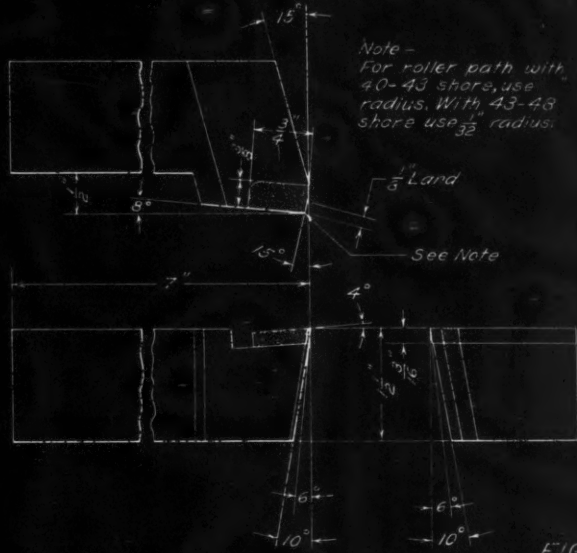


FIG. 20

BORING, COUNTERBORING, AND BACK-BORING TOOL

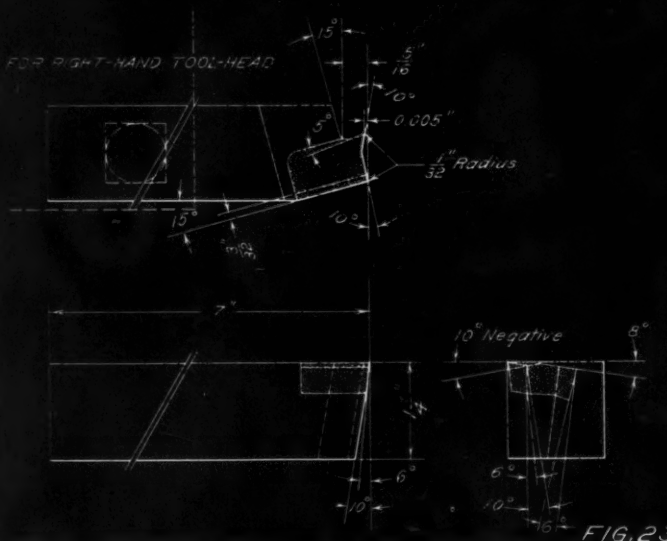


FIG. 23

FACING AND CHAMFERING TOOL

FOR RIGHT-HAND TOOL-HEAD

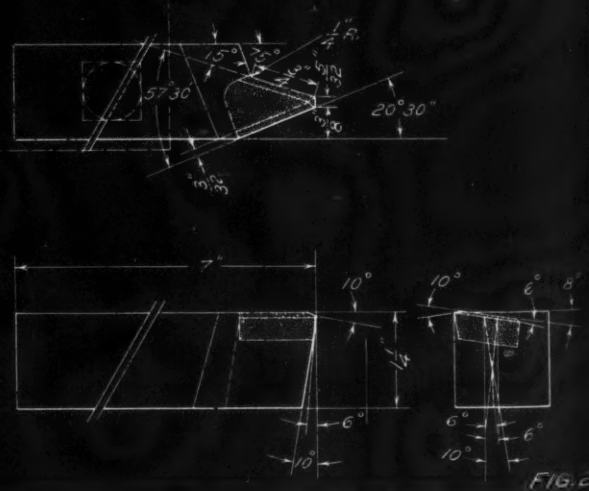


FIG. 24

Figs. 15 to 26. Diagrams of Turning, Boring, and Facing Tools of Various Combinations of Negative

FACING TOOL FOR HARD BEARING STEEL (L.H.)

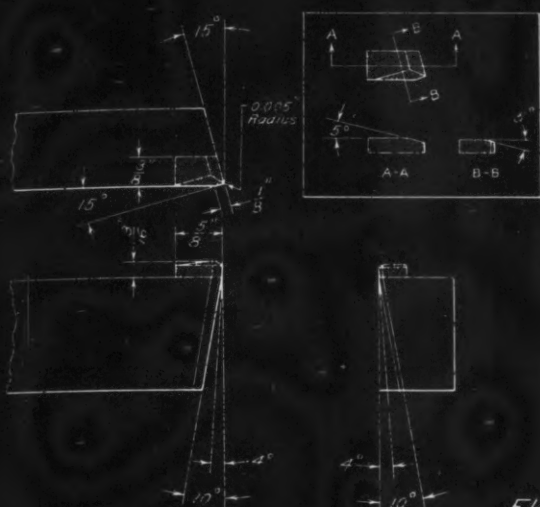


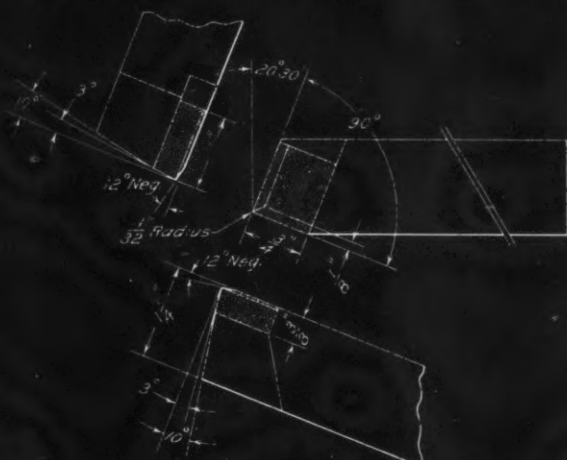
FIG.17

OFFSET RAUGH-BORING TOOL



FIG.18

TURNING AND BOTTOM CHAMFERING TOOL



Tool to be used in left-hand head

FIG.21

TAPER-TURNING AND FACING TOOL

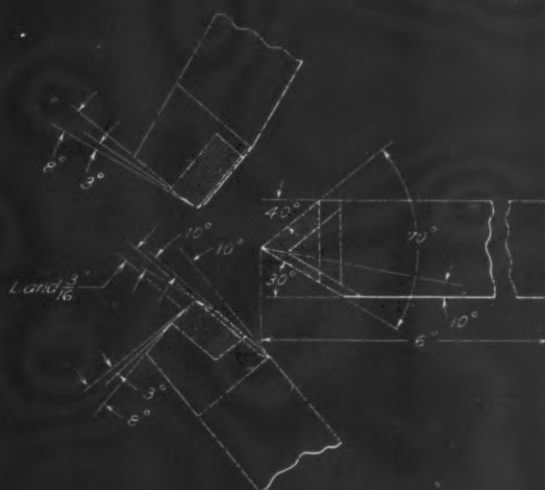


FIG.22

FACING AND TURNING TOOL



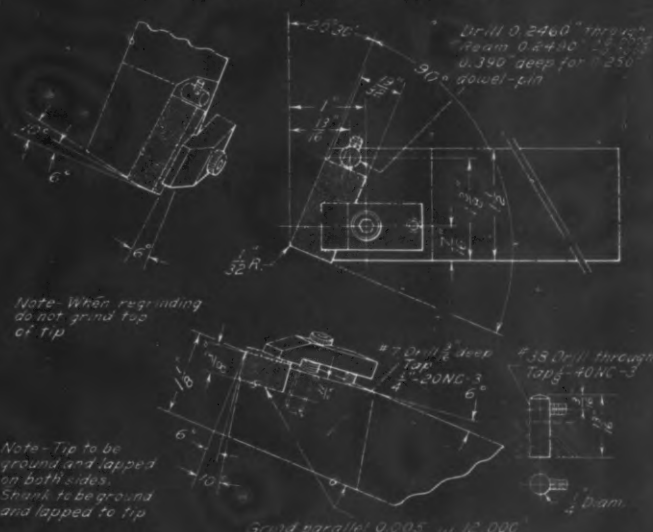
Note- Chip-breaker ground at 6-degree positive angle. Grind chip-breaker before grinding 8-degree negative rake

Enlarged view of chip breaker

Rough and finish O.D. one cut. Use 35 R.P.M. if there is excess stock when facing

FIG.25

BOTTOM CHAMFERING TOOL



Note- When regrinding do not grind top of tip

Note- Tip to be ground and lapped on both sides. Shank to be ground and lapped to tip

Grind parallel 0.005 in 12.000

FIG.26

and Positive Back and Side Rake which are in Extensive Use at Northern Ordnance Incorporated

## NEGATIVE-RAKE TURNING AND BORING

duction demands required a duplicate set-up on another machine. The second machine was of identical year, make, and model; therefore the tool in Fig. 19 was set up with the job on machine No. 2. The same speeds and feeds were employed, but the tool life was much shorter and the finish was very poor.

A complete check showed that the toolposts or rams on the second machine were about  $5/32$  inch ahead of center. To correct this condition without extensive repairs to the machine, all that was necessary was to hold a  $1\frac{1}{2}$ -inch dimension between the top of the carbide tip and the bottom of the tool shank, as shown in Fig. 20.

A boring tool with a double negative land is shown in Fig. 21. This tool, which is another example of a "picture-frame" tool, is used in machining a rough S A E 1020 steel forging. The job is handled on a vertical boring mill, with a cutting speed of about 380 feet per minute, a feed of 0.025 inch, and a depth of cut of 0.125 inch.

The tool in Fig. 22 was designed for the facing of an S A E 1030 steel plate gear blank. This plate is approximately 38 inches in diameter, and the face consists of a series of tapered steps with several drilled holes breaking through each step. Culminating several experiments seeking a gain in speed and tool life, the peculiar tool shown in Fig. 22 was arrived at. The tool operates at approximately 650 feet per minute, with a feed of 0.025 inch and a cut up to 0.375 inch deep.

The boring, back-boring, and counterboring tool in Fig. 23 is used for machining a carbon-steel weldment at speeds exceeding 525 surface feet per minute. The fish-tail arrangement is used in the back-boring operation.

The facing and chamfering tool shown in Fig. 24 has been applied on a vertical boring mill machining a weldment of S A E X1020 steel. The facing cut is taken at 380 feet per minute, and the chamfering cut at 230 feet per minute. In facing, the feed is 0.025 inch and the cut is skin-deep. The depth of cut in the chamfering operation is 0.125 inch.

The machining of a weldment on a vertical turret lathe called for the use of a chip-breaker. Fig. 25 shows a tool whereby shorter tool grinding time was sacrificed for longer tool life. A standard 15-degree turning tool lacking back and side rake was first ground with a 6-degree positive chip-breaker placed parallel to the side cutting edge. After the chip-breaker was formed, an 8-degree negative land was machined across the breaker, as shown in the drawing.

The rough-turning is done at 390 feet per minute, with a feed of 0.025 inch, and a depth of cut of about 0.125 inch. Both the roughing and finishing cuts in the facing operations are taken at an average speed of 506 surface feet per minute. The feeds were 0.043 inch and 0.015 inch, respectively, and the depths of cut 0.250 inch and 0.025 inch.

For long production runs, a substantial saving in shank stock and grinding time can be accomplished by using tools of the type illustrated in Fig. 26. Although the clamping arrangement is quite elaborate, it will be noted that one shank will do the work of four. The tips are ground square with the radii at each corner. No further grinding is necessary, since the tool angles are compounded in the shank. Instead of regrinding the tip each time it becomes worn, it is necessary only to change the position of the tip. This can be accomplished three times, providing four freshly ground tools where previously one only was available. Since the tips are ground square, several can be handled at the same time, employing a surface grinder.

The tools mentioned were, for the most part, standard tools to begin with, and very little effort was required to convert them into useful negative-rake tools. There are, however, instances where conditions require specially designed tools. To cite one example, a Northern Ordnance engineer, dissatisfied with the commercial finish in the ball race of a thrust bearing, asked that the shop attempt the manufacture of the races locally. The bearings were of S A E 52100 bearing steel and were hardened to 62 to 64 Rockwell C. The radius of the ball race was 0.1718 inch. With a standard form tool positioned on the machine in relation to the work so that the effective cutting angle was 8 degrees negative, and turning at a speed of 300 feet per minute, a surface was obtained that proved far superior to the commercially ground races. In addition to good finish, the dimensional accuracy from bearing to bearing was excellent.

Another case where specially designed negative-rake tools were necessary was in the machining of die molds for plastic "O" rings. The material was Carpenter Hampden, heat-treated to 65 Rockwell C. Special negative-rake tools were made to turn grooves in the face of die-blocks in ring diameters ranging from 0.500 to 2.000 inches and having cross-sectional radii from 0.031 to 0.125 inch. The upper and lower mold halves were matched to within 0.0005 inch.

# Precision Measurement of Balls for Instrument Bearings

Measuring Instruments of Extreme Accuracy Must be Used to Insure Readings in Millionths of an Inch

By W. H. MEIKLEJOHN, Development Engineer  
West Lynn Works Laboratory  
General Electric Co.

IN gyroscopic flight instruments, the basic element consists of a small mass rotating at a very high speed. Such devices are exemplified by the electrically driven directional gyro-control unit for automatic pilots, shown in Figs. 1 and 2. It is important that this rotating mass run as smoothly as possible and be as free from self-induced vibration as practicable. These requirements dictate rotor bearings having extremely low and uniform friction torques. [This matter was discussed in a paper by H. M. Witherow and A. Hansen, Jr., published in the *Transactions of the American Institute of Elec-*

*trical Engineers*, Vol. 63, No. 4, 1944, pages 204-208.]

The steel balls in the bearings of these devices (Fig. 3) must be of more uniform size and sphericity than those commonly used in rotating apparatus. If one of the balls in this bearing is thirty-millionths of an inch smaller in diameter than the others, it assumes no load, while the other balls assume 35 per cent more than the normal load. Therefore, the balls for each bearing must be selected so that their diameters do not vary more than a few millionths of an inch, and the measuring device used in selecting them

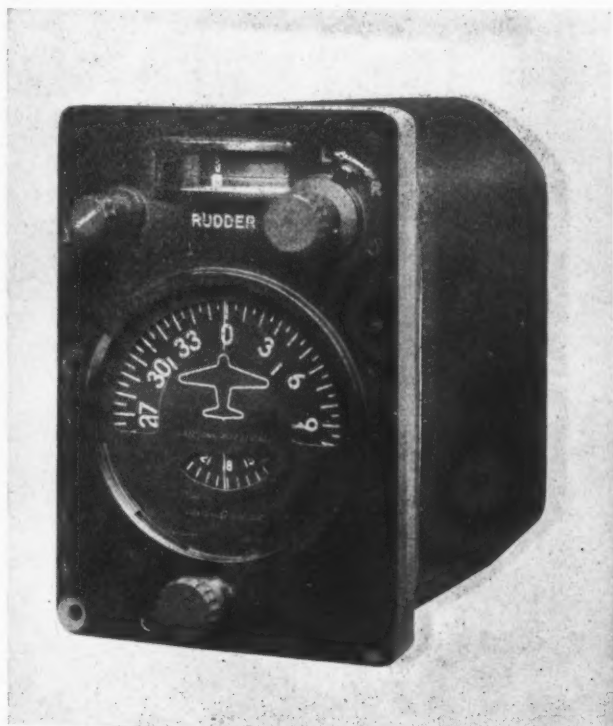


Fig. 1. Directional Gyroscope Control Unit and Indicator

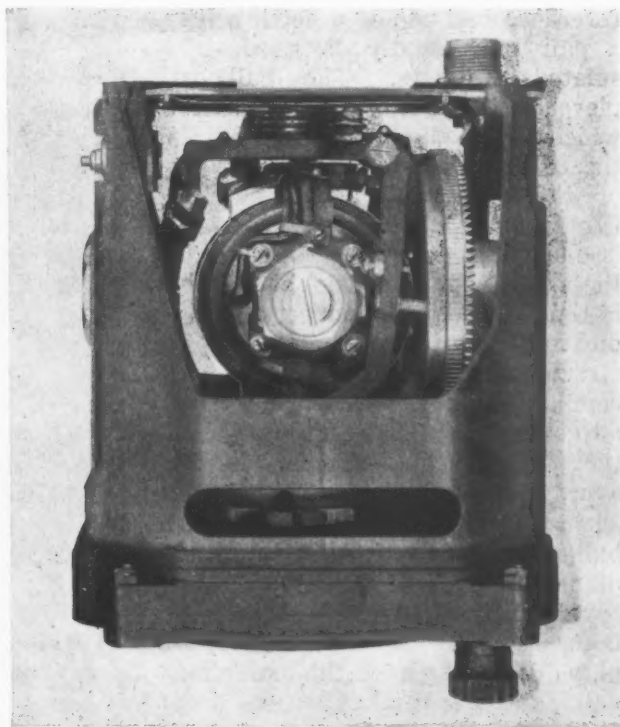


Fig. 2. View Showing Part of Mechanism of Gyroscope Control Unit

must have a precision of one-millionth inch.

A millionth of an inch is indeed a small distance, being equal to the wave length of the longest X-rays. If it were possible to draw two lines ten-millionths inch apart, they could not be distinguished with the most powerful microscope using yellow light, due to the inability of an optical microscope to resolve two images closer together than approximately one-half the wave length of the light used. Measurements of diameter and sphericity of balls for instrument bearings can, however, be made to the required accuracy by means of the Electrolimit gage shown in Fig. 4. [A detailed description of this gage will be found in an article on Electric Gages, by H. P. Kuehni, in the *General Electric Review*, Vol. 45, No. 9, 1944, pages 533-536.]

The operation of the Electrolimit gage is very simple. It is, however, necessary to set the gage with a standard reference ball. To do this, the operator picks up a reference ball out of a bottle with a pair of specially designed, insulated tweezers. The ball is placed in the hole of a holder plate which allows the operator to move the ball around under the spindle of the gage. With the spindle lifted by a pivoted lever, the ball is moved under the spindle and the spindle lowered. A foot-switch is then operated to connect the indicating instrument to the gage circuit, and, since the gage is a comparator, the controls must be adjusted to a definite reading for the reference ball, which is of average and known dimensions. Then the spindle is lifted and the ball moved to measure a different diameter. This is repeated again for a third reading. The ball is then removed from the holder plate, picked up with the tweezers, and put back in the bottle.

The procedure for measuring other balls is the same except that no adjustments are necessary. The balls are placed in various bottles,

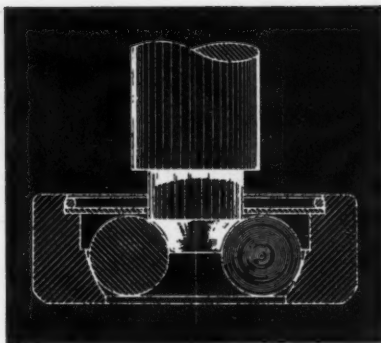


Fig. 3. Cross-section of Bearing for Gyro Rotor

depending upon the diameters indicated. If all three indications are not within a few millionths of an inch, the ball is rejected.

Inherently, the electrical circuit, which is essentially an alternating-current bridge circuit, has ample sensitivity and stability, the problems involved consisting of finding satisfactory methods for eliminating temperature gradients throughout the apparatus, preventing erroneous readings caused by particles

that may be on the ball, spindle, or anvil, and by lapping of the spindle.

## Effect of Temperature Changes

At first it might appear that the most logical location for the Electrolimit gage would be in a controlled-temperature room. However, it is impractical, if not impossible, to maintain such a room at an absolutely constant temperature.

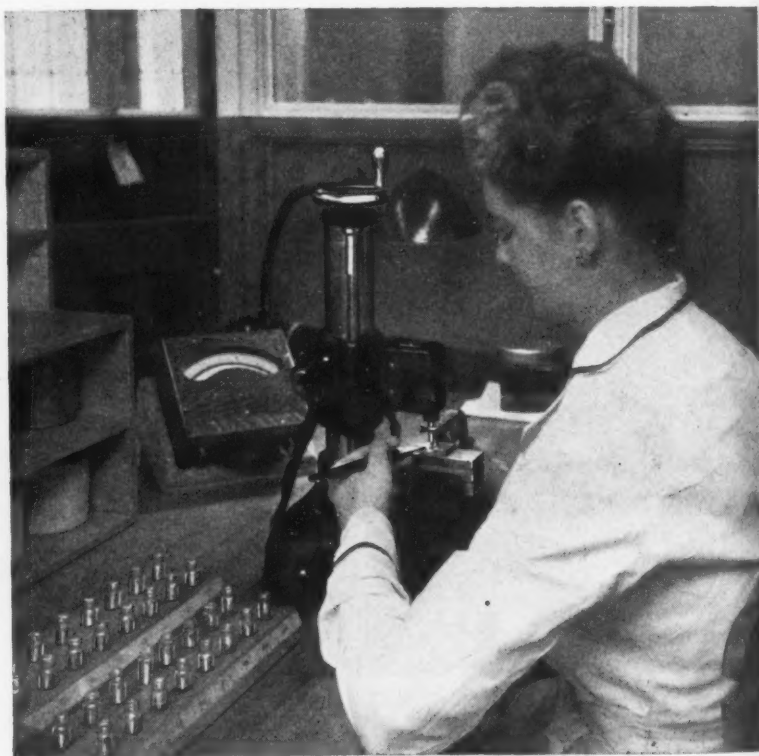


Fig. 4. Using a Pratt & Whitney Electrolimit Gage for Measuring Diameter of Steel Balls

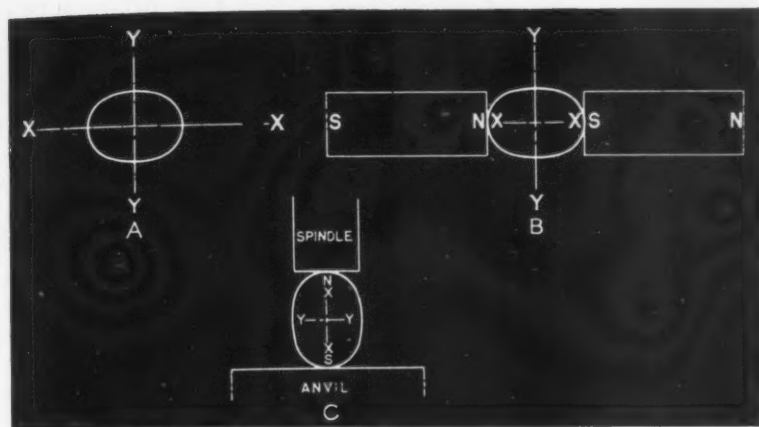


Fig. 5. Sequence of Operations in Measuring the Major Axis of the Ellipsoid-shaped Ball

It has been found that with a controlled room varying  $\pm 2$  degrees C., the ball diameter indications vary with time, as shown in curve A of Fig. 7. This large variation is due to the difference in the thermal mass of the parts of the Electro-limit gage and the rapid changes in temperature during the control cycle.

Constant average temperature over a long period is, however, unnecessary, because the actual diameter of the balls is not important as long as all the balls in one race have the same diameter within a few millionths of an inch. This consideration permits locating the gage in a well insulated room where the average temperature may change continually, but at a very slow rate. Under such conditions, there are no detrimental temperature gradients within the gage, and the balls can be measured with sufficient rapidity to assure negligible change in dimension due to temperature variations from the first to the last ball in a lot of the size handled. The performance of the Electro-limit gage in such a room is shown in curve B of Fig. 7.

The data charted in Fig. 7 were taken in the following manner: The ball was placed under the spindle of the Electro-limit gage by raising and lowering the spindle upon the ball; the operator then recorded the indication as a function of time. This purposely neglects the effect of the proximity of

the operator and the transfer of heat through the tools that must be used. However, by making the tools of heat-insulating material, curves very similar to curve B of Fig. 7, have been obtained when a ball is removed after each reading.

## Effect of Dirt Particles on Measurements

Particles of dust or lint are carefully avoided by special attention to cleanliness of the ball, containers, and atmosphere. However, they could not cause serious trouble in measurement for the following reasons: In the first place, the ball is held between two parallel and flat surfaces when it is being measured. In assuming the initial loading of the spindle, the area of contact is infinitesimally small, and even at full loading this area is still minute. The type of motion involved tends to push particles out of the way, and this action is further facilitated by the film of oil surrounding each ball. Moreover, there is very little chance of errors due to particles affecting the selection of balls, because three different diameters on each ball are measured, and the ball is rejected

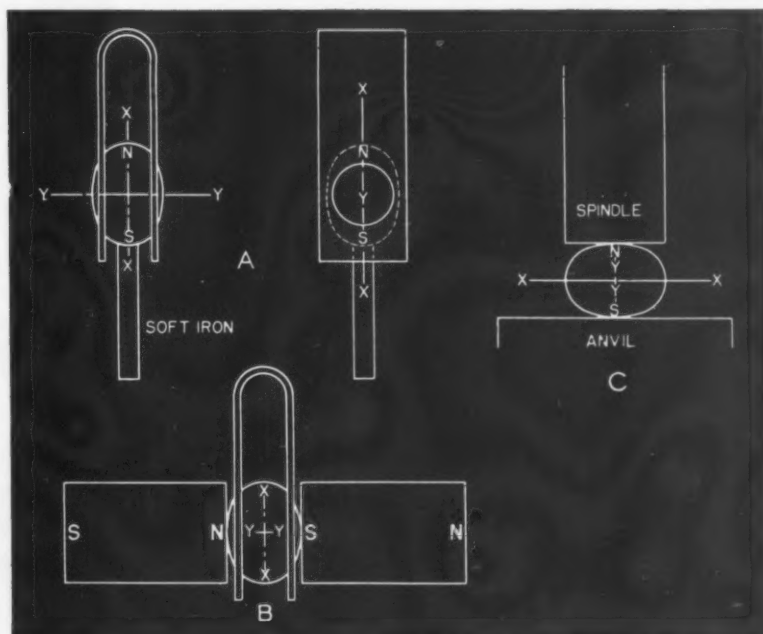


Fig. 6. Sequence of Operations in Measuring the Minor Axis of the Ellipsoid-shaped Ball

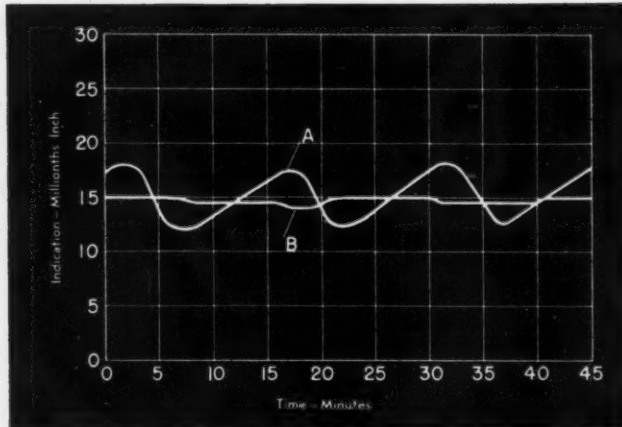


Fig. 7. Curves Showing Effect of Temperature Variations on Indications of Electrolimit Gage. Curve A Shows Variation when Gage is Used in a Heat-controlled Room with Temperature Varying Plus or Minus 2 Degrees C., while Curve B Shows Result in an Uncontrolled Well Insulated Room

if the readings differ by more than a few millionths of an inch.

### Parallelism of Gage Spindle Surface

It is most important that the surface of the spindle which rests on the ball during the measurement be flat and parallel to the optical flat used on the anvil. The rough-lapping of the spindle is performed by using various sizes of abrasives on a steel block which has been ground flat and parallel. The final abrasive used on this block is alumina. For the finish-lapping the charged block is an optical flat with very flat and parallel sides. Fine diamond dust suspended in oil is used as the abrasive. The results of this procedure are readily checked by placing a magnetized ball under the spindle and taking readings at the center, front, left side, back, and right side of the spindle. The purpose of magnetizing the ball before the readings are taken is to be sure that all measurements are made on the same diameter of the ball.

### Effect of Deformation of the Ball

There is one other consideration which might be important, namely, the deformation of the ball during measurement. While this deformation has been shown to be about sixty millionths of an inch by calculation and test, it does not affect the accuracy of the selection operation if it is the same for each ball.

The deformation of a ball held between two flat parallel surfaces is given by the following equation: [See S. Timoshenko, "Strength of Materials," Part II, pages 555-561].

$$\text{Deformation in inches} = 3.08 \sqrt[3]{\frac{L^2}{E^2 d}} \quad (1)$$

where  $L$  is the load in pounds,  $E$  is the modulus of elasticity in pounds per square inch, and  $d$  is the diameter of the ball in inches. This formula holds true only if the elastic limit of the ball is not exceeded. The maximum load which the balls can stand without permanent deformation is as follows:

$$L \text{ maximum} = 700 d^2 \quad (2)$$

For balls of the size used in gyroscopic instruments, the load imposed on them by the Electrolimit gage spindle is much less than  $L$  maximum, and is constant. Therefore, the only factor in the deformation equation (Equation 1) which varies between individual balls is the diameter. Over the range of variations in diameter usually experienced, this introduces an error of less than 0.002 per cent. The effect of deformation on the selection of the balls is therefore negligible.

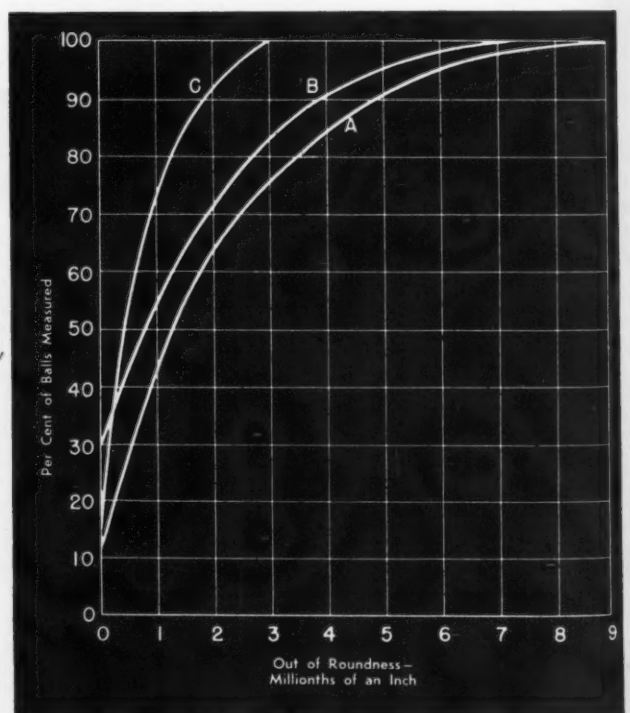


Fig. 8. Curves Showing the Percentage of Balls Found Out-of-round by Less than Amount Indicated

### Measurement of Sphericity

To assure high quality gyro-bearing performance, it is necessary to measure the out-of-roundness of a reasonable percentage of the balls used. This is done by utilizing the inherent property of a paramagnetic, and especially a ferromagnetic, material to align itself in a magnetic field so that its major axis is in the direction of the field. In this measurement, it is assumed that the out-of-round balls approximate an ellipsoid in shape, because of the methods used to manufacture steel balls.

To measure the out-of-roundness of the ball *A*, Fig. 5, it is placed in the field between two Alnico magnets, as shown at *B*. Its major axis *X-X* is immediately aligned with the direction of the field, as indicated. The magnetized ball is then placed under the spindle of the Electrolimit gage, as shown at *C*. Since the spindle is also ferromagnetic, the *X-X* axis of the ball assumes a position perpendicular to the face of the spindle, and a measurement on that diameter is made.

To measure the minor diameter *Y-Y*, the ball is attracted to a small-diameter soft iron rod as shown at *A* in Fig. 6. The magnetized major axis *X-X* of the ball is aligned with the axis of the iron rod. In this position, the ball is clamped with brass tweezers between magnets, as at *B*, so that the *Y-Y* axis is perpendicular to the arms of the tweezers. Held in this position with the tweezers, the magnetism is removed in the *X-X* direction and established in the *Y-Y* direction. The ball is then removed from the magnets and is placed under the spindle of the Electrolimit gage as at *C*. The ball is now attracted to the spindle with the *Y-Y* axis perpendicular to its surface, and a measurement of this diameter is made. The difference between the two readings is the out-of-roundness of the ball.

The value of out-of-roundness obtained is not influenced by magnetostriction effect to any measurable amount. This is because the change in dimension of the ball due to the magnetic field will be less than one-quarter of a millionth of an inch. Actually, the measurement of out-of-roundness is not even influenced by this amount, since it is determined by the difference in two dimensions of the ball, both of which will be influenced by the magnetic field to approximately the same degree. [See "Applied Magnetism," by T. F. Wall, pages 101-106].

The results of measurements of sphericity are shown in Fig. 8. These curves show the percentage of the balls found out-of-round by less

than a certain amount. Curves *A* and *B* represent measurements on two groups of balls from one lot of the same manufacturer. Curve *C* shows the results obtained with another manufacturer's product.

By the use of the Electrolimit gage and the methods here outlined, steel balls can be matched to within a few millionths of an inch, thereby making possible accurate balance of rotors and such a reduction of friction as to assure unusually long life of bearings in electrically driven gyroscopic instruments for aircraft.

\* \* \*

### Individual Enterprise Alone Brings Prosperity and Employment

The depression in the thirties, which was partially caused by unsound ideas of investment and over-confidence in economic stability, was greatly prolonged by the fact that American business men and the American Government turned sharply from one extreme to the other. Having made one mistake, Government and business, instead of taking its medicine and starting out with fresh courage, lost confidence in business potentialities and in the security of investments, with the result that production, employment, and purchasing power declined.

As pointed out by Stevenson, Jordan & Harrison, Inc., management engineers, the war has ostensibly changed these conditions; but we should not forget that it has not solved our economic problems. When the war is over, the same business courage and enterprise that made this the leading industrial nation in the world will be needed to an ever increasing extent, and we will require Governmental policies that will give individual enterprise an opportunity to function.

It is most unfortunate that Governmental policies that suppress and limit free individual enterprise have come to be known as "liberal." They are anything but liberal. They suppress and hamper those who alone can act as leaders and guides in the search for greater well-being and prosperity for the nation.

\* \* \*

The use of cemented-carbide gage fingers has insured accurate gaging during the grinding of aircraft cylinder sleeves in a large engine plant in Detroit under conditions which would wear steel fingers away so rapidly that the operator would be forced continually to reset his gage.

# Utilizing Rubber Dies in Hydraulic Presses

Use of Rubber in Die Cutting and Forming Operations on a Type of Hydraulic Press Developed by the British Ministry of Aircraft Production

**D**URING recent years, a considerable advance has been made in England in the design and application of hydraulic presses fitted with rubber dies, particularly in connection with the production of large quantities of varied parts required for the aircraft industry. Presses of new design have been developed by the Machine Tool Directorate of the British Ministry of Aircraft Production as a result of extensive investigations into the rubber die process. These presses are larger and capable of exerting greater total pressures than those heretofore available. They have been designed entirely with a view to economical production, and are proving very satisfactory.

It was customary when this process was introduced to employ a standard platen upon which the rubber die descended. This practice has been reversed in the presses now designed, the hydraulic ram being contained within the base casting while the platen moves upward into a fixed press head. A housing is provided integral with the head casting to receive the rubber die. Some of the earlier presses used for this work were fitted with single large-diameter rams which moved downward against a fixed platen. This arrangement has certain disadvantages and was discontinued.

A progressive development of the process has made it necessary to increase the size of the

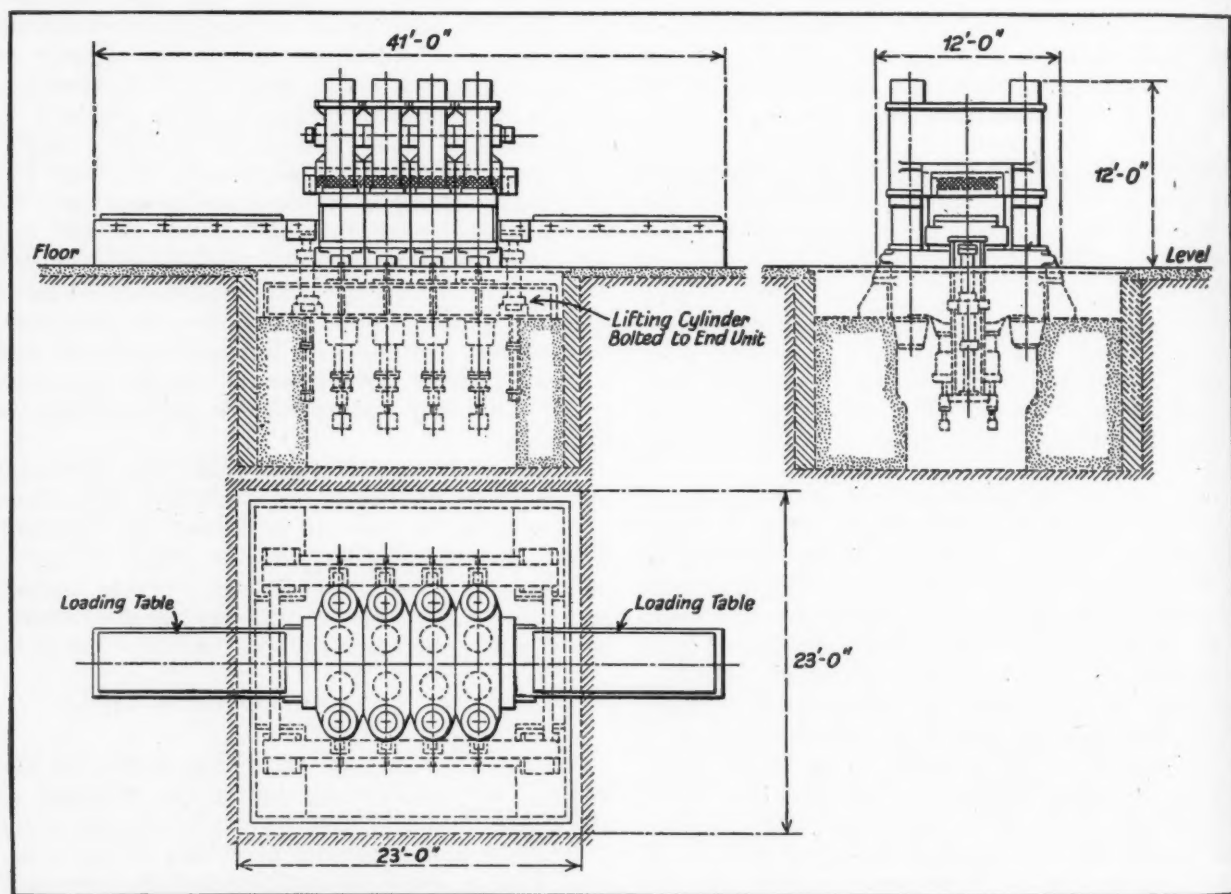


Fig. 1. General Arrangement of Four-unit Hydraulic Press in which Rubber Dies are Used. A Pressure of 1.54 Tons per Square Inch is Produced over a 36 Square Foot Area

platen, as well as the working pressure applied to its surface. To avoid the necessity of using large steel castings for the press head structure, a form of unit construction has been introduced in the new type press. By utilizing a number of hydraulic rams, the pressure is distributed more uniformly over the platen area. Fig. 1 shows a general arrangement of a four-unit press of this type.

Before describing more fully the essential features of these new presses, a brief discussion of the method of their application with rubber dies will be given.

### Operations with Rubber Dies

The principle upon which this use of rubber depends relates to its peculiar physical characteristics. Its compressibility is approximately 0.04 per cent per 100 pounds per square inch pressure, and it has a comparatively high yield point, which, of course, varies with the hardness of the rubber. A range of from 350 to 650 per cent elongation is suitable for all rubber die work (Fig. 2).

The method of application of rubber dies is as follows: A rubber pad is housed within a steel container strong enough to withstand the total bursting pressure due to the working pressure on the platen. The thickness of the rubber die or pad should be about two-thirds the depth of the container; a platen fits closely into this container to form a confined space. The platen is preferably secured to the cross-head of the press and moves upward into contact with the rubber.

Dies are grouped over the surface of the platen, and the sheet metal to be processed is interposed between the dies and the rubber pad. When pressure is applied, the platen forces the metal sheet against the dies; deformation of the rubber then takes place, causing the metal to be bent or formed to the shape of the die, as shown in Fig. 3. As deformation proceeds, a stage is reached when the rubber entirely fills the container. Additional pressure causes compression of the rubber, which transmits the pressure to the metal blank and forms it.

If separate blanks are used for each component, they are positioned by locating pins on the dies. However, if a single sheet is being formed into blanks, economical grouping of the dies is arranged and the sheet placed over them. Pressure is then applied, and with one stroke of the ram, all blanks are simultaneously formed. Forming dies should be about 1/4 inch thicker than the depth of the flange to be formed. Dies 3/4 inch thick are suitable for most flanging operations.

The procedure of shearing blanks for a large number of components is to group the shearing dies over the loading table in such a way that

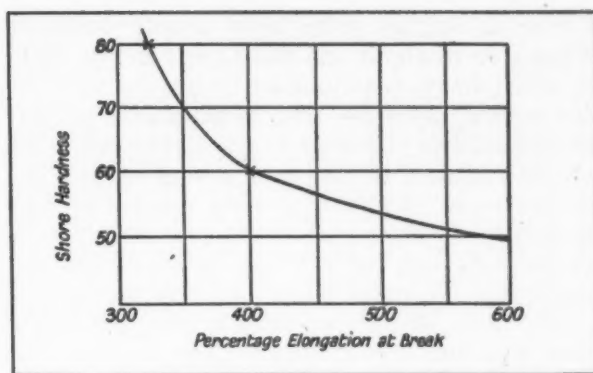


Fig. 2. Percentage Elongation at Break-down Point of Rubber Ranging from 50 to 80 Shore Hardness. Rubber in this Hardness Range is Suitable for Dies

they will occupy the entire surface of a stock-size sheet. This sheet is placed over the dies and the pressure applied. The resulting sheared edge is not sharp. A state of compression is produced at the edges, but there is freedom from sharpness or "draw" lines.

With regard to durability of rubber as a material for dies, its life will be considerably extended if entirely confined within the pressure container and not stretched beyond its elastic limit by undue deformation when the working load is applied. It is important that the platen should be a good fit in the pressure container to prevent the rubber from being extruded around the sides and damaged.

The degree of hardness of the rubber used is decided by the depth of the drawn part. When flanging, forming stiffening ribs, or beading, say, the edge of lightening holes, a Shore hardness of 75 is suitable, whereas if deep drawing is to be done, a softer type of rubber is used. For depths of from 4 to 6 inches, rubber with a Shore hardness of 55 to 60 is suitable.

In flanging operations, if the rubber is too soft, it becomes excessively deformed and tends to flow behind the metal, thus preventing the flange from being properly formed. When, however, the rubber is of suitable hardness, its deformation is less at a given pressure, and the flanging is completed before the rubber gets behind the metal to prevent it. (Fig. 4).

Formerly, these rubber dies were built up from a series of laminations 1 1/2 to 2 inches thick, bound together with an adhesive or vulcanized. This method of construction has certain disadvantages, and is now superseded by solid rubber dies, which are mechanically more sound and more satisfactory in use.

On account of the great weight of solid rubber dies, in the larger sizes—from two to three tons—a very strong form of suspension must be used. A highly satisfactory method is to secure a steel backing plate to the rubber. One method of doing this is to use a plate that is perforated

all over its surface with holes counterbored on the top side to about one-third their depth. Rubber, when in its plastic state, is forced into the holes under pressure and vulcanizes. In this way, the rubber is locked to the plate with what is, to all intents and purposes, a very large number of rivets. The plate, with the rubber die attached, is secured within the pressure box by a number of long bolts which pass through the press head. To remove the die, it is only necessary to raise the platen into contact with the rubber and unscrew the bolts. The die can then be lowered with the platen.

These rubber dies are of a hardness sufficient to insure that the elastic limit is not exceeded when in use. When they have been in use for some time, however, the working surface becomes rough and pitted. This does not affect its efficiency; if anything, a coarse working surface is an advantage, as it prevents adhesion between the rubber and the work. It will be appreciated that if the platen is brought into

contact with the rubber surface under pressure, a considerable force would have to be applied to separate them. When the rubber surface is rough, this condition does not arise, but if the die has a smooth surface, it is advisable to interpose something between the surfaces to break the contact. A piece of thin rope, roughly zig-zagged over the surface of the plate, will serve this purpose.

If the working surface of the rubber becomes badly damaged locally, this can be repaired without removing the rubber by grinding away the surface to expose fresh rubber with a portable grinder having a flexible drive. The recess is then filled with uncured rubber in semi-plastic form, after which the ram of the press is lowered until the die rests on the bolster. Heat is now applied to the rubber, and the ram left in this position until vulcanization is completed. If the entire surface of the die pad has become very uneven through extensive use, the pad should be removed from its container and resurfaced. The new surface should not be left smooth, but should be corrugated to prevent adhesion when in contact with the bolster. This is very important. The force required to overcome adhesion of a 9- by 4-foot rubber die could easily amount to more than 35 tons.

With a press of the descending ram type, catch stops are usually provided to put the press in a safety position and keep the rubber off the platen when not in use. When the ram operates upward, however, it is normally at rest and in a safety position at the bottom of its stroke, and no stops or safety devices are necessary.

### Thickness of Rubber Required

The thickness of rubber used depends principally upon the depth of the drawn parts required. For general forming, flanging, and shallow drawing operations, 9-inch thick rubber gives satisfactory results, and rubber dies of this thickness have been standardized for the unit presses here described. The die is accommodated within a pressure container deep enough to hold the rubber displaced when the formers and blanks are pressed into it, leaving room for the platen to enter. The latter must be a good fit, in order to insure that the rubber will not be extruded between the sides of the platen and the pressure box.

### Conditions of Successful Working

Successful use of rubber-die presses on magnesium-aluminum alloys is due to improvements in the control of the time cycle, and it should be said that ordinary mechanical power presses are usually unsuitable for rubber-die work, since it is possible for a condition to arise where the accumulated energy of the flywheel would build

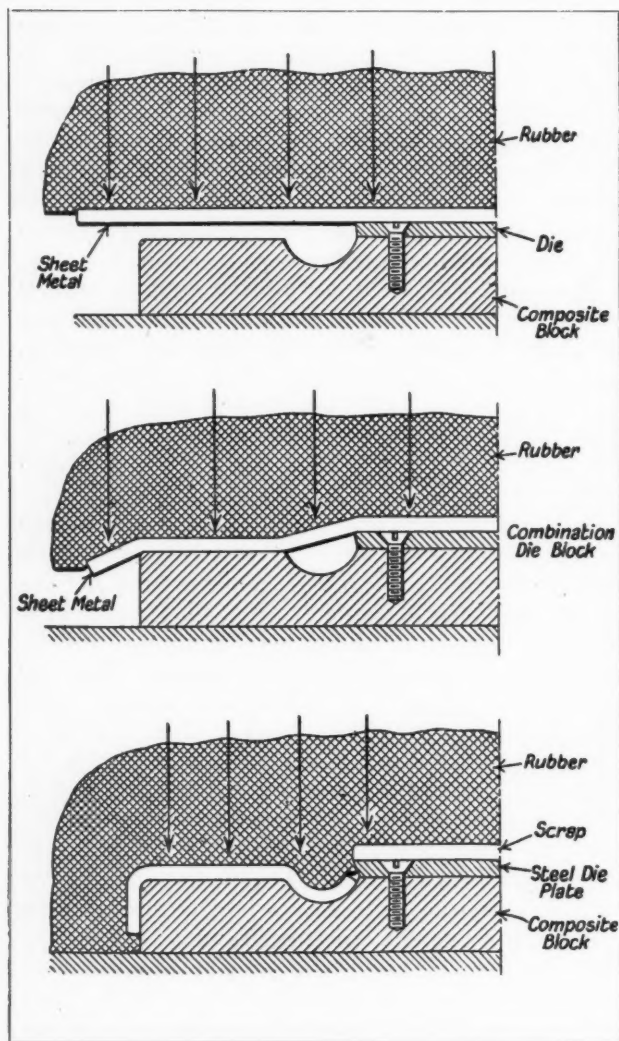


Fig. 3. Successive Stages in Forming the Beading on the Edge of a Lightning Hole

up a pressure in the restrained rubber sufficient to stall the press and cause damage.

Aluminum and some of its alloys tend to drag with steel dies. This phenomenon corresponds to some extent to the seizing of a dry bearing, and is very pronounced with aluminum, causing considerable difficulty. The trouble is caused by metal-to-metal contact, forming excessive friction between the surfaces, and although actual seizure does not occur, the metal surface is damaged. Alclad is a troublesome metal in this respect, owing to its laminated formation, and unless great care is taken in setting up the dies, the aluminum sheathing will be stripped off. This difficulty is not encountered in the rubber-die process—a valuable feature when working light alloys, owing to the fact that the die is softer than the metal, and therefore cannot cause drag lines, although sufficient pressure is transmitted by the rubber to shape the metal.

A common cause of failure in working any metal is that not enough time is given to allow the metal to flow uniformly—a condition particularly necessary when magnesium-aluminum alloys are being worked. If the metal to be formed is homogeneous and free from internal strain, it can be drawn at a moderately high speed. Physical variations, however, exist, and it is necessary to “persuade” the metal and not force it to flow.

### Rate of Flow in Metals

The behavior of the internal structure of metals cannot, of course, be observed, but what takes place can be demonstrated to some extent by suddenly removing the ends of, for example, a rectangular tank containing a thick layer of mercury. The resulting rapid flow of metal toward the ends will cause the mercury pool to rupture near the center, whereas if the ends are separated gradually and the flow slowed down, the thickness of the mercury can be reduced to a very thin layer without separation occurring. This rate of flow varies with different metals, and it is therefore necessary in practice to select methods of working that can be controlled to provide conditions suitable to each.

The experiment mentioned demonstrates to some extent that even a metal that is perfectly homogeneous and free from internal strain must, when it is to be uniformly drawn, be given time to allow the structure to accommodate itself; otherwise it will break down.

For raising or forming flanges, stiffening ribs, lightening holes, and bulkhead panels, temporary dies made of seasoned hard wood are suitable when only a few hundred of these are required. If faced with metal to serve as protection, several thousand parts can be produced. Composite materials, made of fine wood chips cemented into a solid mass with a suitable bind-

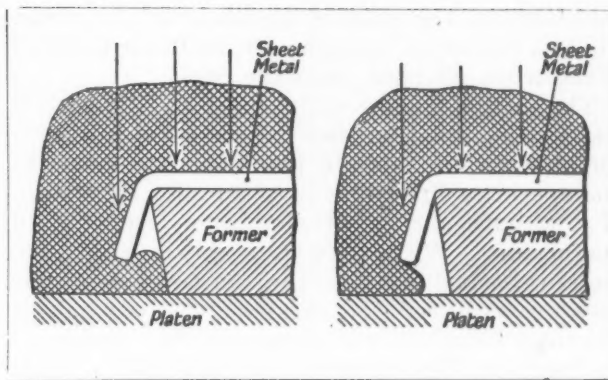


Fig. 4. If the Rubber is too Soft, it Flows Behind and Obstructs the Sheet being Formed, as Shown at the Left. When Harder Rubber is Used, This Difficulty is Not Experienced (see Right-hand View)

ing material and finally compressed into sheets, are used to form laminated blocks. These composite slabs are known by trade names and are obtainable through merchants. If, however, more permanent dies are required, these can be cut from 3/4-inch thick zinc sheet spun to shape. The advantage of using zinc is the convenience of being able to remelt it to form new dies.

Dies are sometimes cut from mild steel plate, a cutting blow-pipe being used for the purpose. A “dwell” machine is employed to finish the profile. This type of die makes a permanent forming tool, and can be produced at a fraction of the cost of hardened steel dies. Sometimes steel plates having similar outlines, but slightly smaller than the size of the die, are used to form cover plates and serve to remove local dents in the material. The blank to be formed and cover plate located on the former are positioned on the locating pins attached to the forming die. A curved zinc die has a tendency to open due to the pressure of the rubber, and to avoid this, it may be anchored to a steel backing plate.

All dies should have a small radius to avoid sharp corners being formed on the work. For cold-working, the radius should be equal to three times the thickness of the sheet being processed, and this is particularly important where metal in an aged condition is being flanged. It may be mentioned that it is not necessary to have all the dies the same thickness; the rubber pad will accommodate itself to variations. If, however, dies of different heights are assembled on the platen together, they should be kept sufficiently far apart to allow the rubber to reach the surface of the platen in the space between the dies.

When the working pressure per square inch on the platen is not high enough to prevent creep after the pressure has been removed, it is common practice to back off the die face sufficiently to compensate for any elastic recovery of the metal. Usually, about 4 degrees of backing is

satisfactory. The greater the power of the press, the less the metal tends to return to its original shape when released from the press.

The metal should be worked in its softest state. Combination dies which serve to form components and also to blank out the holes in one operation are made from an alloy consisting of zinc with a trace of aluminum, copper, and magnesium. When used as a shearing die, the metal is backed off to an angle of 6 degrees. The pressure required for shearing will depend on the total length of the shear and the nature of the material. The shearing dies can also be made of composite materials faced with chromium-molybdenum steel to form a shearing edge.

Using steel shearing dies, sheets up to 18 gage can be blanked without a trace of burr on the sheared edges, and holes can be pierced successfully down to 1/2-inch diameter. Holes smaller than this cannot be satisfactorily blanked out. Shearing dies are normally from 1/4 to 1/2 inch thick and made of steel plate. As an example of blanking, a fuselage frame can be sheared from a 4- by 4-foot sheet of 17-gage Dural. The pressure required to do this is about 4500 tons. Sheet steel of 36 tons tensile strength has been sheared successfully up to a 16-gage thickness with simple steel dies and rubber pads.

#### *Using Rubber Dies for Drawing Duralumin*

Drawing operations can be carried out on Duralumin. The drawing die is placed on the platen with the blank interposed between it and the rubber pad. A piece of rubber sheet about 1 inch thick is used to form a pressure pad. This controls the flow of metal during drawing. The pressure pad should be large enough to cover the blank and should be cut away to correspond with the shape of the part to be drawn.

Suitable pieces of rubber having a Shore hardness of between 60 and 70 are placed over the blank where it is to be drawn. Pressure is then applied, causing the loose rubber to force the metal into the die. The pressure is now taken off, and more loose pieces of rubber inserted to further extend the draw during the second stage. The metal is forced about half way down the die during the first stage. It is then annealed and the process repeated.

During the second stage it is drawn about one-third the amount of the draw during the first stage, each successive draw becoming less until the metal makes contact with the bottom of the die. Provided the material is well annealed, an 8-inch draw can be completed in five stages, 4 inches during the first stage, 1 3/4 inches in the second, 1 inch in the third, 3/4 inch in the fourth, and 1/2 inch in the final stage. Wrinkles sometimes develop during the stages; these should be hammered out as they occur before proceeding with the next draw.

The pressure required for this drawing operation will obviously depend on the thickness and nature of the material. Alclad sheets of 18 gage can be drawn with pressures up to 500 pounds per square inch. Referring to wrinkles, a convenient way to remove these without damaging the metal is to hammer them out with a rubber tool. This can be made from a piece of 1-inch thick rubber narrowed down to form a handle.

In all drawing operations, it is desirable to use a lubricant between the rubber and the metal being processed. Oil or grease should not be used, but a dry lubricant of powdered French chalk or graphite gives satisfactory results. Before drawing commences, the rubber pad holds the metal blank tightly on the die, and as the draw proceeds, this pressure becomes greater and prevents undue movement. If the draw is relatively deep, it may be necessary to apply additional clamping pressure to stabilize the flange. This can be done by forming a bead around the edge of it.

A trial run should be made to determine the size of the blank and the width of its flange. The die-blocks for drawing are conveniently made from seasoned hard wood, 1 1/2 inches thick, and glued and screwed together to make up the required depth. A piece of 1/8-inch steel plate is usually screwed to the top section to protect the edges of the wood. Generally speaking, the metal can be drawn about half the required amount on the first anneal, and then in stages of one-third and one-quarter the amount of the initial draw. Before the final draw, the metal should be normalized. The extent of each draw should be determined first by trial.

The hydraulic press, with its modern system of control, provides features enabling the best conditions of working to be obtained, some of the more important of these being variations in speed, gradual "inching," and ability to dwell at the end of the power stroke. Thus, flexible conditions are available whereby the pressure can be applied to suit the internal physical characteristics of the material.

With the ever increasing number of aircraft parts to be produced, platens of much larger area have now become necessary, and as many as sixty parts of varying size and shape can be grouped on the platen and formed or sheared during one cycle of the press. An important feature of the parts produced in rubber dies is the entire absence of draw lines.

In conclusion, it may be remarked that these presses are very massive structures, each individual unit weighing approximately 85 tons. A four-unit press weighs 340 tons and gives a pressure of 1.54 tons per square inch over an area of 36 square feet. The total working pressure developed by a four-unit press is 10,668 tons. The over-all length is 41 feet, and the height and width 12 feet.

# Machine Equipped to Hob Internal Gears

By L. ARICO and J. SULLIVAN, Steam Division  
Westinghouse Electric & Mfg. Co., South Philadelphia, Pa.

**I**NTERNAL involute gear teeth are usually formed by shaping or broaching operations.

In the case of gears of large diameter, however, the equipment required may be considered special. When confronted with the problem of producing several internal gears of 100-inch pitch diameter, it was found that the special equipment required to produce the gears in accordance with the usual practice was not only very expensive but difficult to obtain. Furthermore, the time required for cutting the teeth would be much longer than for hobbing teeth on external gears of the same size and length.

To overcome these disadvantages, a standard

gear-hobber was equipped as shown in the accompanying illustrations. With this equipment, it is possible to cut involute gears accurately, rapidly, and economically. The fixture has a special geared drive, and is mounted on the swivel head of a 160-inch gear-hobbing machine.

The fixture and hob are designed with a view to obtaining uniform spacing and tooth shape. The drive itself is simple, but the development of the proper form for the hob is something of a problem. It was accomplished by grinding standard hobs in place on the gear-hobbing machine, modifying them so that their faces were accurate fits in the tooth spaces of a finished gear.

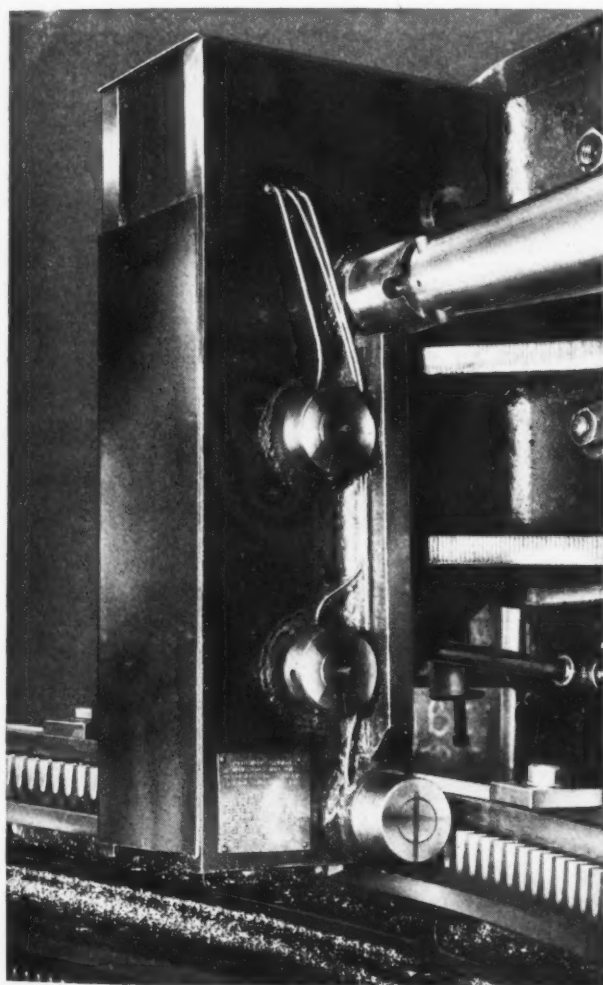


Fig. 1. Standard Gear-hobber Equipped with Special Geared Drive for Hobbing Teeth on Internal Gears of Large Diameter

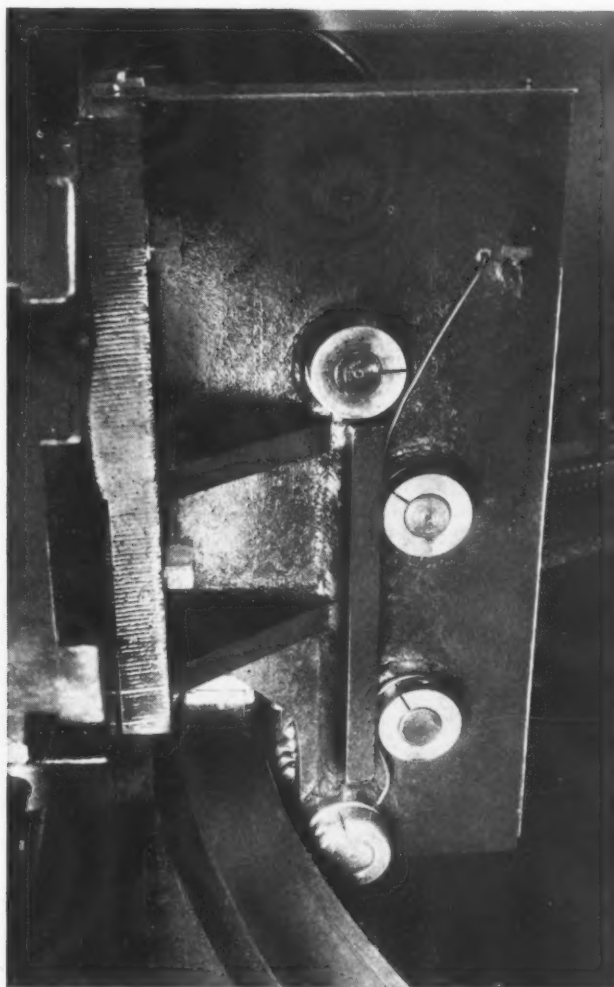
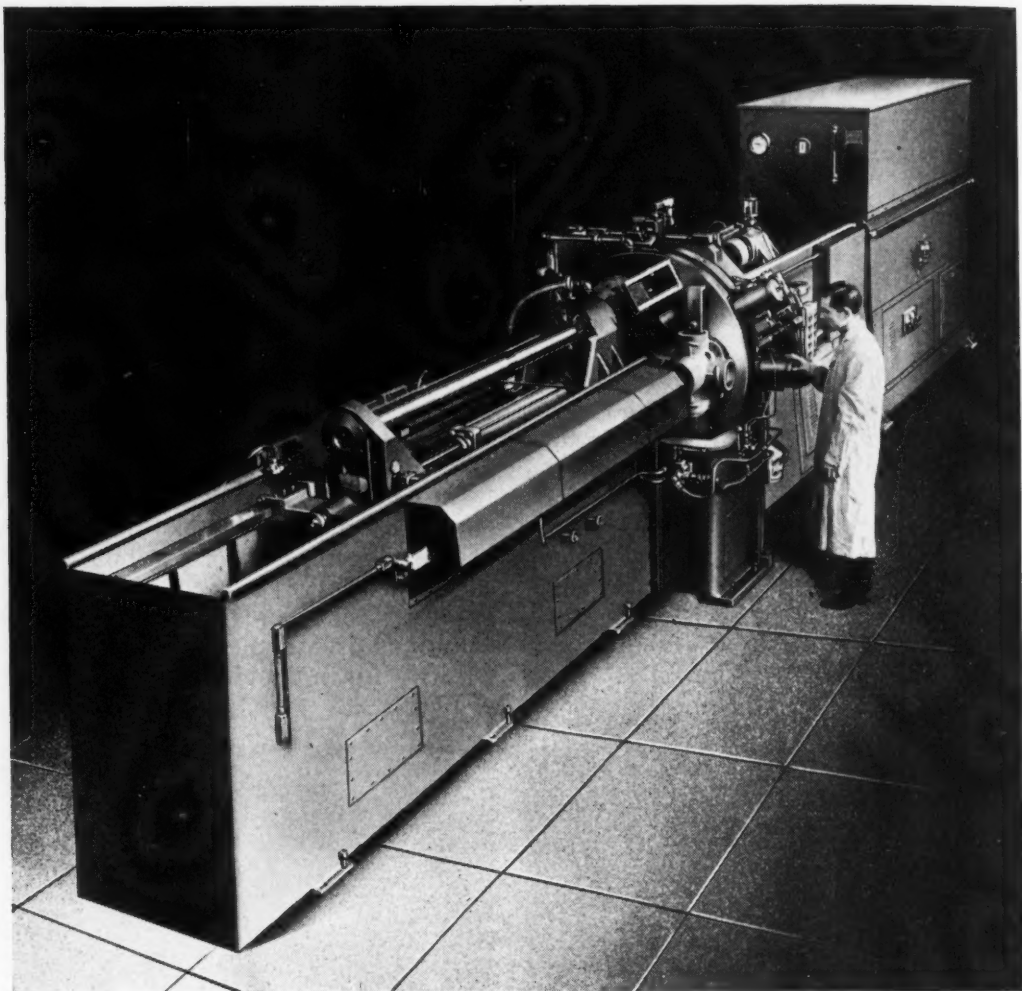


Fig. 2. Side View of Special Geared Drive and Mounting for Hob Employed in Hobbing Internal Gear Teeth



# Broaching Applied in a Constantly Broadening Field

Broaching, Once Thought of as Applicable Chiefly to Keyways and Splines, is Today Replacing Many Other Types of Machining Operations in Mass-Production Manufacturing Practice

By O. W. BONNAFE, Development Engineering  
The Lapointe Machine Tool Co., Hudson, Mass.

**B**ROACHING is no longer a mere auxiliary operation in the machining of metal parts. Today broaching machines and broaches are used to an ever increasing extent in the quantity production of the most varied parts. While even before the war broaching practice had reached a remarkably wide field of application, the machines developed for the manufac-

ture of war materials and the methods employed in war plants have called the attention of a constantly growing number of production engineers to this process. In the present article, a number of unusual examples of broaching machine applications will be illustrated and described.

The heading illustration shows a Lapointe semi-automatic hydraulic broaching machine

**Fig. 1. Machine for Broaching the Internal Contour of a Forging as Indicated Diagrammatically in Fig. 3**

used for machining the hub of airplane propellers. This machine employs two broaches. The outstanding feature of this machine is not the amount of stock removed, but the accuracy obtained.

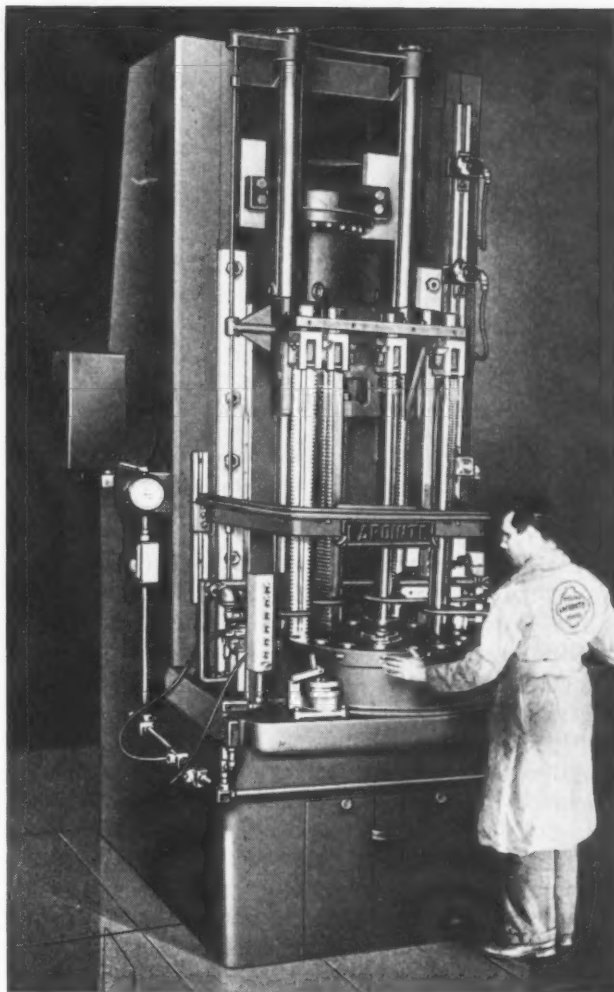
The interior of the hub being broached has forty-four teeth or splines, the appearance being somewhat similar to an internal gear. All the splines are cut at once. The allowance on the pitch diameter is 0.003 inch, but extreme accuracy is required on the flank of the splines, where the deviation must not exceed 0.0003 inch.

As may be noted from the illustration, there is a loading position where a new hub is mounted while the broaching takes place. The two broaches, indicated more clearly in Fig. 2, operate at the same time, two hubs being in the operating position while a third is being loaded. The broaches are approximately 100 inches long, and are guided on both sides of the work to insure accuracy. The machine has a 75-ton pulling capacity. The production obtainable with this machine is fifteen hubs per hour.

#### **Broaching Internal Contour of Forgings**

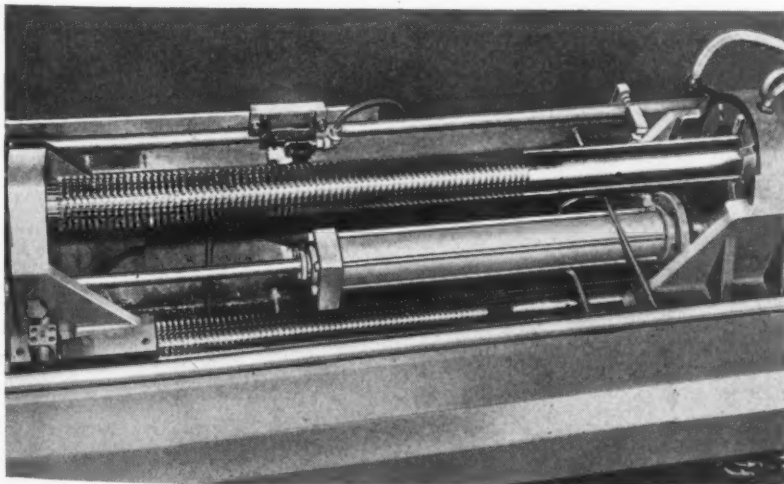
An unusual broaching job is performed on the machine shown in Fig. 1. As indicated in the diagrammatic view, Fig. 3, the internal contour of a forging is broached to shape, the heavy line indicating the broached surfaces. The material being broached is very hard—from 385 to 400 Brinell. The accuracy on the diameter of the broached surfaces of the finished part must be within a tolerance of 0.001 inch.

Four broaches are used for this work, three for roughing out the metal, and one for finishing the contour. In this case, only one broach is pulled through the work at each stroke of the

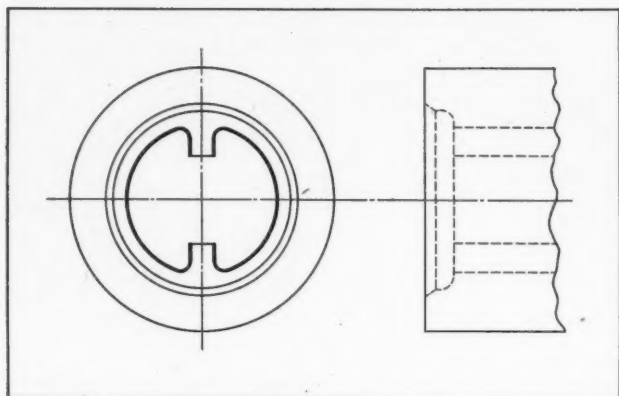


machine. In light work, obviously, all four broaches could operate at each stroke; but in this case, it requires 35 tons to pull through a single broach, and the machine has not been powered to handle this heavy work with four broaches simultaneously, which would, obviously, require close to 150 tons.

Fig. 4 shows the broaching of the inside of another forging. As may be noted from the



**Fig. 2. Close-up View of the Broaches Mounted in a Lapointe Semi-automatic Hydraulic Broaching Machine for Broaching the Inside of Airplane Propeller Hubs**



**Fig. 3. Diagrammatic View Indicating the Surfaces being Broached in Machine Shown in Fig. 1**

illustration, the machine is provided with a horizontal turret or turntable into which the forgings are loaded after having been placed in loading pots with locating lugs, assuring that the required keys will be broached in the proper position. A fixture for placing the forgings in the loading pots is shown in the lower part of the illustration. In setting up, the machine is operated by hand; after that, it can be operated as a fully automatic machine, the operator simply loading and removing the work. If desired, the machine can also be operated as a semi-automatic—that is, the machine will make one complete cycle and stop. The production, when operating automatically, is fifteen parts per hour—that is, four minutes per part. Four broaches, 74 inches long, are used, all the broaches operating at each stroke of the machine.

**Fig. 4. Broaching Machine Equipped with Four Broaches for Operating on the Inside of Four Forgings at One Time**



### **Making Spring Pack Retainers**

Fig. 6 shows a machine used in manufacturing a U-shaped piece (shown enlarged in Fig. 5) for aircraft propellers, known as a "spring pack retainer." It is made from S A E 6150 steel, heat-treated to 350 Brinell. These parts are made from bar stock, two bars being passed through the machine at once, one on top of the other. The bars are approximately 0.514 inch wide by 0.291 inch thick. The machine is fully automatic, and can be compared in its action to that of an automatic screw machine in that the bars are fed through the machine while the broaches perform successive operations upon them until the finished piece is cut off.

How the machine performs its automatic cycle is indicated diagrammatically in Fig. 7. Three broaches rough the three rectangular slots *A* while three other broaches finish the three rectangular slots *B*. On the other side of the bar, three broaches rough the half-round surfaces *C* while three others finish three half-round surfaces *D*. Finally, three cut-off broach blades at *E* cut off the parts from the bars. Since there are two bars, one on top of the other, six finished parts are obtained for each stroke.

After the completion of one stroke, the bars are fed forward three steps and the operation of the fifteen broaches is repeated. When a set of bars is nearly used up, the next two bars are brazed to them so that the machine can run continuously twenty-four hours a day. The average output is fifteen completed retainers per minute, or at the rate of 900 an hour.

The tolerance on the width of the rectangular

gap of the retainer is 0.001 inch; the depth of the gap has a tolerance of 0.003 inch; the width of the leg has a tolerance of 0.001 inch; and the outside radius has a tolerance of 0.005 inch. The sides of the gap must be parallel within 0.001 inch, and the tolerance on the minimum thickness at the inside corners of the gap and the outside radius is 0.001 inch. The inside corners must be sharp, and the finish on the inside of the legs must be without any blemish.

Fig. 6 shows the automatic fixture by means of which the feeding of the bars is controlled. While feeding for the next cycle, the bars are entirely clear of the broaches. The controls are a combination of hydraulic and electric means, and the machine is so arranged that it will stop immediately should any of the functions not operate as expected.

### *Machining Recess in Gun Breech-Ring*

Fig. 8 shows a machine built for machining the recess in a heavy-caliber gun breech-ring by broaching it completely from the cored hole. Approximately 40 pounds of metal are removed on the 75-millimeter gun breech-ring and 100 pounds on the 90-millimeter breech-ring.

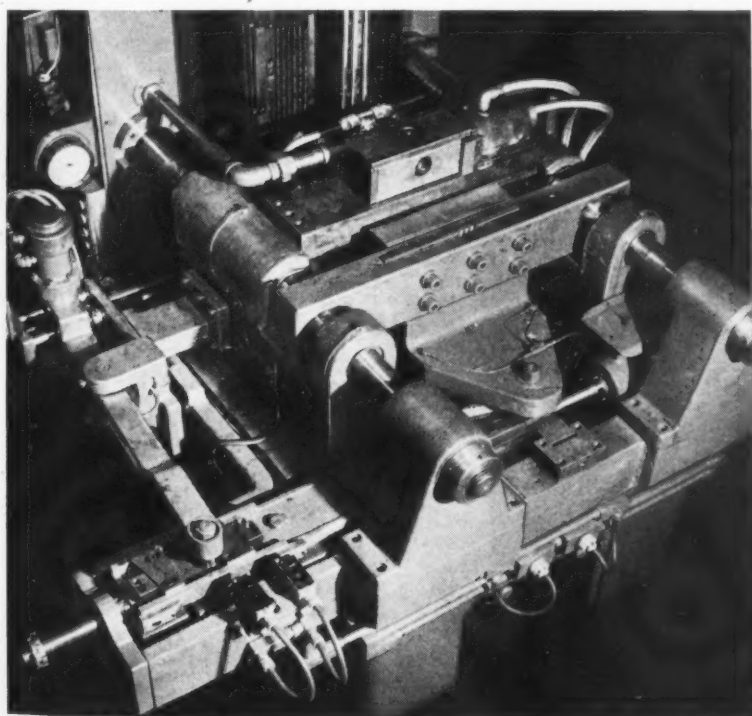
For loading and unloading the work, a shuttle type fixture, operating from center to left or center to right, is used, so that one breech-ring can be loaded while the other one is being broached, as indicated in the illustration. Directly in front of the operating mechanism of the loading fixture, there is a turret type fixture in which eight broaches are mounted. Each of these broaches is hydraulically operated. At the start of the

operation, the first broach is in line with the breech-ring. It is automatically hooked up to the pull-head and pulled through the ring. At the end of the stroke, the loading fixture shuttles back to the center of the machine and the broach returns to the starting position. The turret then revolves to the next position, and the next broach is operated in the same manner.

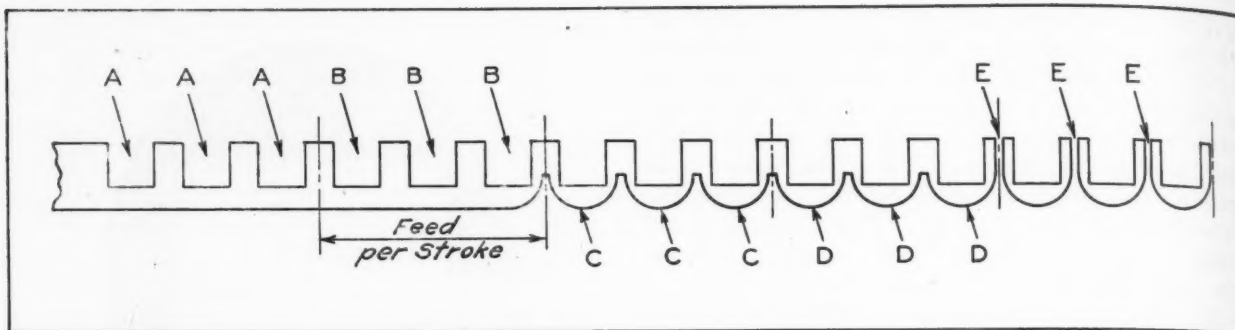
In due time, the operator moves over to the other side of the machine, loads the fixture, and the operation is repeated on the breech-ring mounted on that side. There are two sets of controls on the machine, and a selective switch determines from which side the operator is to work. Fig. 9 shows the cover at the end of the



*Fig. 5. Spring Pack Retainer Made in the Machine Shown in Fig. 6*



*Fig. 6. Automatic Fixture which Controls the Cycle in the Making of the Spring Pack Retainers Shown in Fig. 5 by Broaching*



**Fig. 7. Diagrammatic View Indicating the Sequence of Operations in the Making of Spring Pack Retainers in the Automatic Broaching Machine Shown in Fig. 6**

turret removed, exposing the turret-operating mechanism.

It used to require forty-five hours to machine the recess in these heavy-caliber gun breech-rings. Through the use of this broaching equipment, the machining time for each breech-ring has been reduced to eleven minutes. In other words, it took approximately 200 times as long to machine these breech-rings by the old methods.

One of the greatest developments aiding the production of gun barrels, from 0.22 caliber up-

ward, is exemplified by the use of broaching for rifling the barrels. By means of a broaching operation, the barrel is not only rifled, but also finish-bored.

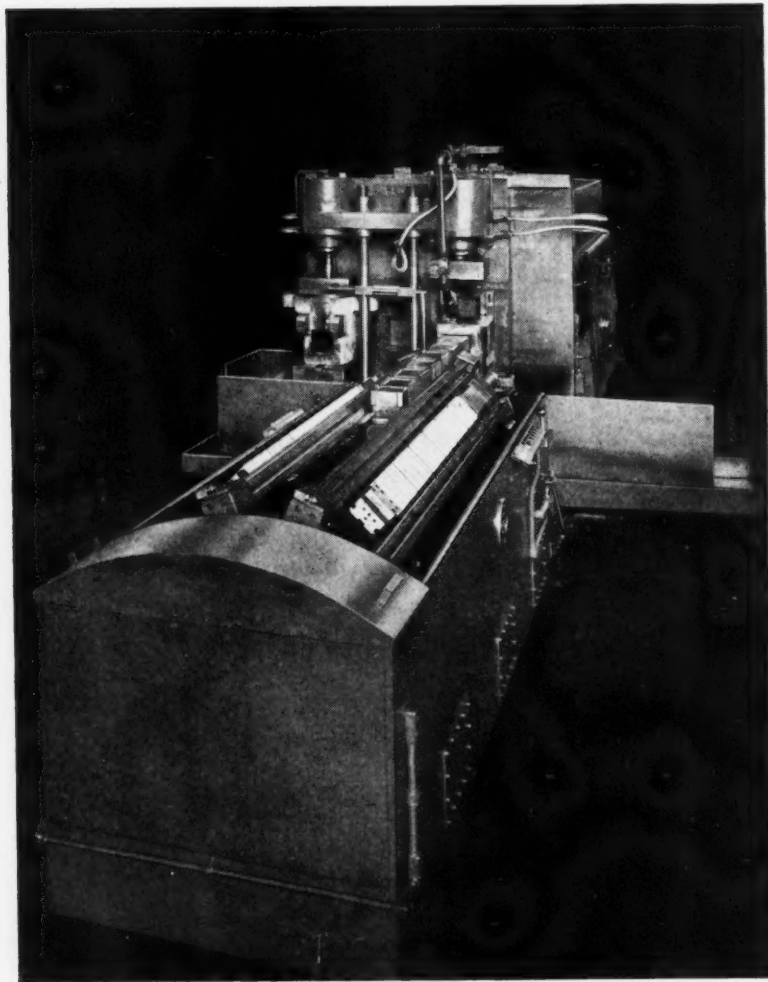
While, formerly, the operations required for finishing a 0.30-caliber rifle barrel involved from one and one-half to two hours (machine time) for reaming, and twenty-seven minutes for rifling, the barrels are now taken directly from the rifle drilling machine and rifled at the rate of 100 an hour, net production. Furthermore,

a better rifling job is obtained, the tolerance on the bore being 0.0002 inch. A tremendous saving in floor space is also effected, as two or three machines will produce the equivalent of a battery formerly occupying an entire department.

\* \* \*

### Plastic Coatings for Overseas Shipments

Since plastic coatings have been found exceptionally valuable for the protection of overseas war shipments, the Youngstown Miller Co., Sandusky, Ohio, has developed a machine that is known as a "Plastic Coater." These machines are designed to melt ethyl cellulose compound and other plastic coatings for protecting parts and tools that are to be stored or shipped overseas. The equipment can also be used for melting low-temperature plastics employed for permanent coatings.



**Fig. 8. Machine with Shuttle Fixture and Broach Turret for Machining Recess in Breech-rings at the Rate of One Every Eleven Minutes**

## "Fiberglas" Insulation — A Most Versatile Material

During recent years glass in fibrous forms has become a most important insulation material for varied uses in industry. There are more than one hundred "Fiberglas" products serving all industries, but all of them are made from four basic forms—wool, filters, textiles, and mats. All forms are incombustible, with high-temperature resistance; durable, since the fibers do not rot or decay and are resistant to almost all chemicals; moisture-resistant; and sanitary, since they provide no sustenance for bacteria, insects, or vermin.

The strength of glass fibers is most remarkable. Fine fibers have strengths up to 250,000 pounds per square inch. Glass yarn exceeds in strength all other textile yarns of equal weight or diameter. In fact, glass fibers of the smallest practicable diameters have a tensile strength greater than that of any known material—greater even than steel.

The wool forms are characterized by light weight—from 1 to 9 pounds per cubic foot; low thermal conductivity; good sound absorption; and suitability for temperature ranges from sub-zero to 1000 degrees F. The filter forms are suitable for air filtration and aeration packs for industrial purposes. The fibrous textile forms are used for electrical insulation, high-temperature industrial textiles, and for reinforcement in laminated products in conjunction with plastics. The mat forms are used as storage battery retainer mats, acoustical surfacing, reinforcement for electrical insulating plastics, and filtration.

Fiberglas is used as insulation in stoves, ranges, ovens, refrigerators, water heaters, industrial boilers, trucks, trailers, buses, railroad cars, merchant ships, etc. Fiberglas in blanket form is used for insulating pipes at temperatures up to 1000 degrees F.

One of the most important uses of Fiberglas yarns and cloths is in electrical insulation for motors, generators, panel

boards, etc. Fiberglas has made possible the design of lighter and smaller motors. This was clearly brought out in an exhibit of Fiberglas electrical insulation recently held in New York by the Owens-Corning Fiberglas Corporation.

Woven Fiberglas is used for welding curtains in factories, and outside of industry is used for draperies and curtains in theatres, hospitals, etc., wherever fire safety is an important factor. After the war, it is likely that Fiberglas will be used to an ever increasing extent both in industry and in other fields.

\* \* \*

## Long Life of Rubber Belt

An unusual record of nearly fourteen years of unbroken service in driving a generator in a stone crushing plant, during which the driving rubber belt traveled about 1,200,000 miles, is reported by the B. F. Goodrich Co., Akron, Ohio. The endless belt, installed in March, 1931, is 105 feet long. It has not changed its position since it was "broken in." It is treated occasionally with belt dressing. The driving speed is 4600 feet a minute, or 52 miles an hour.

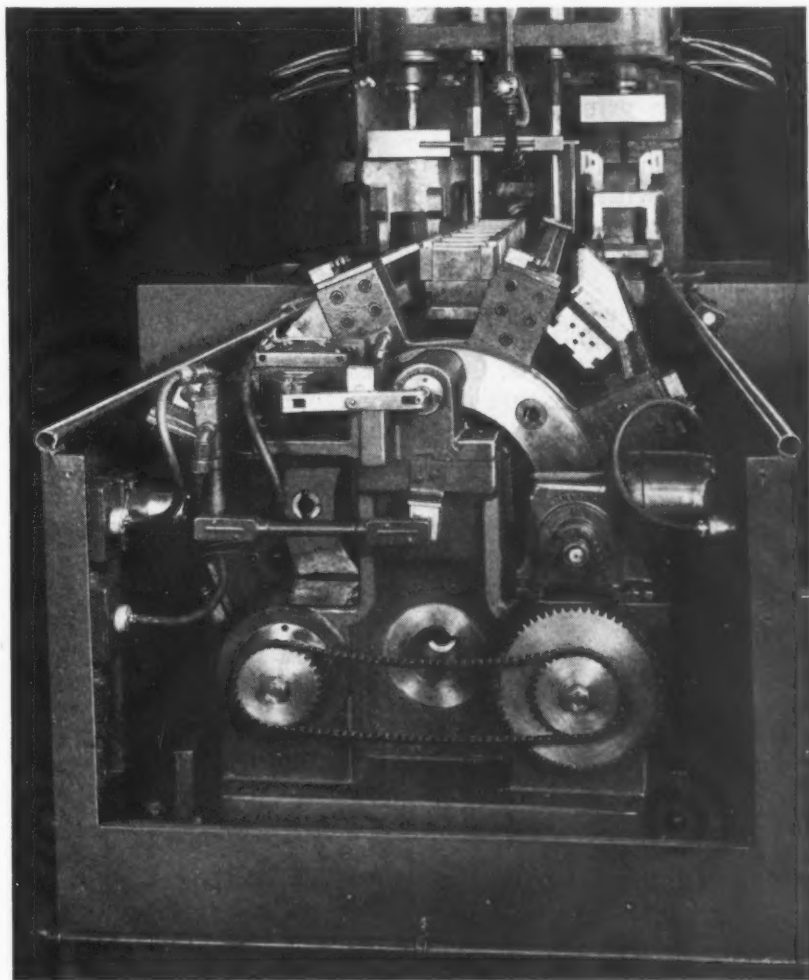


Fig. 9. Close-up View of the Broaching Machine Illustrated in Fig. 8, Showing Turret-operating Mechanism for the Broaches

# Progressive Die Principle Applied to Production Milling

By ENOCH SOUTHALL  
Electric Appliance Division  
Westinghouse Electric & Mfg. Co.  
Mansfield, Ohio

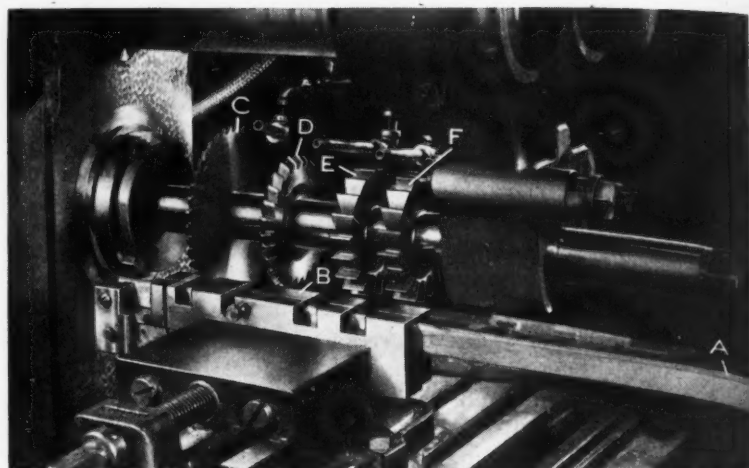


Fig. 1. Milling Machine Equipped with Progressive Fixture for Production of Piece Shown at W, Fig. 2

**P**UNCH presses equipped with progressive dies in which stock is moved from one station to another to produce a completed piece at the final station at each stroke of the press have been employed for many years. In Fig. 1 is shown a milling machine equipped with a fixture designed to apply this familiar progressive die principle to the production milling of small parts from bar or rod stock. The bar stock is clamped in the fixture *B*, which is shown in Fig. 2 with the stock removed. At every feeding movement of the milling machine table, each of the four cutters removes metal from the bar stock.

The principle of progressive milling as applied to the production of piece *W*, Fig. 2, is illustrated by the diagrams Fig. 3. Assume that bar *A* has been fed into the fixture up to the stop *S*, indicated in view *G*, and clamped in this position. The bar is then fed past the cutters *C*, *D*, *E*,

and *F*, which remove metal as indicated, cutter or saw *C* cutting off a blank piece *T*. The bar *A* is then moved to the left to locate the end against stop *S* for the second cut, as indicated in view *H*. On the second cut, an incompleting piece *U* is cut off by cutter *C*. The three other cutters remove metal as indicated, cutter *E*, for example, removing metal as shown by dotted lines at *L*, at the right of the slot milled by cutter *F* in the preceding operation.

In the next or third cut, with the bar again moved up to the stop, as indicated at *J*, another incompleting piece *V* is cut off. On the fourth cut, the stock again having been moved up to the stop *S*, as indicated at *K*, the cutter *C* cuts off a finished piece *W*. Thus, the fourth cut on the bar stock produces a completed piece.

As compared with the practice of performing each milling operation in a separate fixture or set-up, the progressive milling method saves

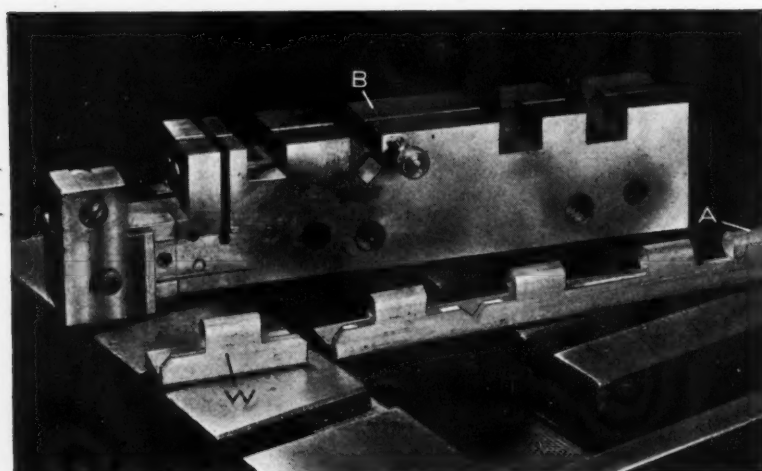


Fig. 2. Progressive Milling Fixture and Completed Piece *W* Cut from Bar *A* on Fourth Milling Cut, with Bar Clamped in Fixture as Shown in Fig. 1

three loading and unloading operations and insures a better quality of work. After setting up the progressive milling fixture and checking the first few pieces produced, accurate pieces will be obtained as long as the milling cutters remain sharp.

\* \* \*

### Preparing for Post-War Work Without Interfering with the War Effort

The Heppenstall Co., Pittsburgh, Pa., is urging manufacturers to place orders now for requirements needed later for peacetime production. Manufacturers are asked to do three things: (1) Make an immediate analysis of reasonable needs to begin post-war business; (2) place un-rated orders for this material or equipment to be delivered as soon as war restrictions permit; and (3) advise customers to do the same.

The placing of orders that are not to be delivered until the war effort permits does not interfere with war production; but it gives each manufacturer some conception of what business is ahead of him at the end of the war; and he, in turn, is able to make tentative plans accordingly.

In this connection it might be mentioned that industry and labor should not be entirely blamed for the shortage of certain types of war material. Some of these needs were apparently not expected by our Army and Navy and adequate provision for ordering this equipment was not made. Several instances have been recorded where manufacturers have not been permitted to deliver to the full capacity of their shop facilities. It is possible that these manufacturers could have taken orders for some of the critical munitions had they been approached in ample time. The demands of the armed forces change according to the type of campaign, which, in many instances, cannot be definitely foreseen. To intimate that industry and labor have not done their share under these circumstances is, therefore, not wholly fair.

### Free Enterprise Necessary to Engineering Progress

In a recent address, Alfred P. Sloan, Jr., chairman of the General Motors Corporation, pointed out that engineering progress—or real progress in any direction—has never been possible except among nations who have had a large measure of individual liberty.

Said Mr. Sloan: "You will find that as men obtained their liberty, their freedom of action, and an opportunity to exert their ingenuity, progress was intensified. You will find that where freedom of action was denied the individual, progress was limited; frequently, it even stopped. There are some very dramatic lessons in history on this point.

"Now, I hold that today we are gradually losing our economic freedom. We never will have the economic freedom in the post-war era that we had in the pre-war years unless we fight more intelligently and better for it.

"We are traveling down a road, the end of which we do not know, and too many of us show no interest in what the end is going to be. We fail to recognize the fact that when men lose their economic freedom, they lose their political as well as their personal freedom. That result is inevitable."

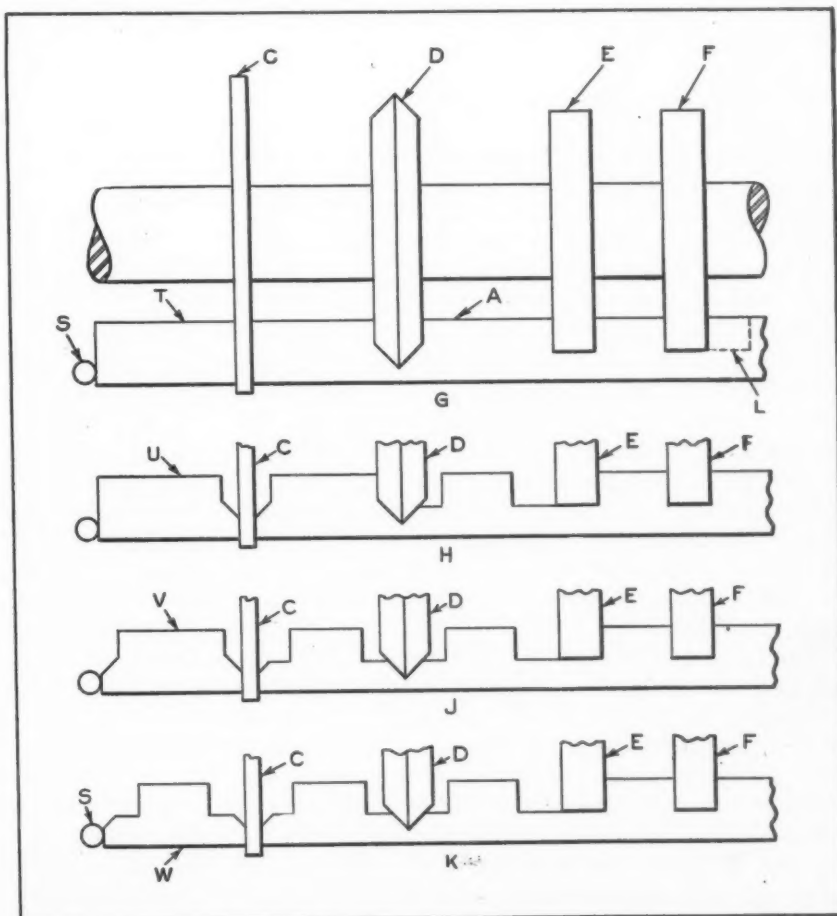


Fig. 3. Diagrams Illustrating Progressive Milling Principle Used in Producing the Part Shown at W in Fig. 2

# Machine Shop Practice Discussed by Mechanical Engineers

**A**T the annual meeting of the American Society of Mechanical Engineers, recently held in New York, over two hundred papers were presented on almost every phase of mechanical engineering. There were several sessions on machine shop practice and metal-cutting, at which many papers of a fundamental character were presented.

One session was devoted entirely to the subject of milling. Two papers were presented. The first, "An Analysis of the Milling Process," by M. E. Martellotti, research engineer of the Cincinnati Milling Machine Co., dealt specifically with the subject of "down milling," the author having at a previous meeting of the Society covered the principles of conventional or "up" milling. This paper traced the development of "down" milling (frequently also known as "climb" milling), and pointed out the advantages that in many instances can be gained by performing milling in this manner. By means of slow-motion moving pictures, he illustrated exactly what takes place when milling cutter teeth engage the surfaces being milled and showed the effects of changing the factors involved.

## *New Data on High-Speed Milling*

A paper entitled "Further Researches in High-Speed Milling" was presented by Hans Ernst, director of research of the Cincinnati Milling Machine Co. In this paper, the author carried forward an account of his research work into high-speed, and especially negative-rake, milling. This paper also was illustrated by slow-motion moving pictures, which showed clearly the difference between positive-rake and negative-rake milling and also emphasized the superior results obtained when milling at high speeds with negative-rake cutters.

At another metal-cutting session, Fred W. Lucht, development engineer of the Carboloy Company, presented a paper on "Some Fundamentals to be Considered when Milling Steel with Carbides."

The basic mechanics of the metal-cutting processes were analyzed in a paper read at another session by M. E. Merchant, mechanical engineer of the Cincinnati Milling Machine Co. In this paper, the author presented a mathematical analysis of the geometry and mechanics of metal-cutting processes. This analysis offers a key for the study of metal-cutting problems in terms of such fundamental quantities as strain,

rate of shear, friction between chip and tool, shear strength of the metal, and work done in shearing the metal and in overcoming friction.

## *Advances in Materials and Processes*

The Metals Engineering Division of the Society sponsored two sessions at which metals and metal-working processes were featured. B. B. Betty and W. A. Mudge, of the International Nickel Co., presented an instructive paper on "Some Engineering Properties of Nickel and High-Nickel Alloys"; J. C. Mathes, development engineer of the Dow Chemical Co., spoke on "New Applications of Magnesium from the Design and Service Standpoint"; Archibald Black, of Simmonds Aerocessories, Inc., discussed "Some Recent Developments in Ferrous and Non-Ferrous Metals"; and L. F. Williams, of the Bessemer Corporation, dealt with "Relative Cost of Castings and Welded Structures in Diesel Engine Design."

"The Trend in the Use of Welded Machinery Parts" was quite completely covered in a paper by E. J. Charlton, of Lukenweld, Inc., while Carl Himmelright, of the Warner & Swasey Co., brought out some interesting and valuable ideas in a paper "Indicated Principles for Post-War Machining."

## *Tool Developments and Tool Control*

Tools for cutting metals received a great deal of attention at the meeting. Centralized tool control was dealt with by W. E. Ainsworth, master mechanic of the tool shop at the Puget Sound Navy Yard, who, in a paper entitled "Tool Control Practiced at Puget Sound Navy Yard," showed how unnecessary duplication of duties has been eliminated and how tools have been made more readily available when required. Furthermore, careful preservation of tools is provided for. To accomplish these results, a service organization has been developed, which is operated under the supervision of the shop superintendent.

Methods of mounting cemented-carbide cutter blades were covered by W. L. Kennicott, of Kennametals, Inc., whose paper was entitled "Methods of Mechanically Mounting Cutting Blades of Solid Cemented Carbide." A survey covering the tipping of tools for the purpose of conservation of cutting tool materials was presented by Frank J. Oliver, technical editor of *The Iron Age*.

A brief abstract of a more extensive paper on "Diamond Cutting Tools," by Paul Grodzinski, of the research department of the Diamond Trading Co., London, England, was presented at the same session as the two papers just referred to.

### ***New Developments in Thread Grinding***

At another session on metal-cutting, W. Fay Aller, director of research of the Sheffield Corporation, spoke on "New Development Made Possible by Plunge Form and Thread Grinding and the Crush-Dressing Method of Grinding Wheels." The author claimed great savings in equipment, economy in perishable tools, and accelerated production through the use of new wheel-dressing methods. He dealt quite completely with crush-dressed wheels, which he said cut more freely, produced less heat, and achieved greater production of parts, with less waste, than wheels dressed in the conventional manner.

The finish of metal surfaces was discussed by Leo P. Tarasov, research engineer of the Norton Co., in a paper entitled "Relation of Surface Roughness Readings to Actual Surface Profile." The author gave approximate multiplying factors for converting profilometer readings into peak-to-valley roughness.

The procedure and the results of an investigation with the calorimetric process for determining the force required for drilling were outlined by A. O. Schmidt, research engineer of Kearney & Trecker, Inc., in conjunction with Professor O. W. Boston and W. W. Gilbert, of the University of Michigan, in a paper "A Thermal Balance Method and Mechanical Investigation for Evaluating Machinability." In this interesting investigation, the temperature rise of water surrounding the tool and test bar during the cutting operation was determined and the horsepower computed from the temperature changes. The results thus obtained agreed closely with dynamometer results.

### ***Investigations of Cutting Fluids at Varying Temperatures***

Professor O. W. Boston, in conjunction with W. W. Gilbert, associate professor, and R. E. McKee of the Department of Metal Processing, College of Engineering, University of Michigan, presented the results of an investigation to determine the influence on cutting speed, tool life, chip formation, and other pertinent factors of a cutting fluid which is applied at several different temperatures in a range of from 55 to 150 degrees F.

T. F. Githens, mechanical engineer, Cleveland Twist Drill Co., in his paper "Helical Taper

Reamers Milled with Constant Helix Angle," provided a solution to the problem of obtaining a constant helix angle in the flutes of tapered reamers.

### ***Bearings and Lubrication***

Three papers concerned with bearings and lubrication were presented at a session dealing chiefly with lubrication. At this session, A. F. Underwood, of the General Motors Research Laboratories, read a paper on "Rotating-Load Bearings," which contained many valuable suggestions for designers. Ernest K. Gatcombe, of the Massachusetts Institute of Technology, presented a paper on "Lubrication Characteristics of Involute Spur Gears," in which he analyzed mathematically the lubricating oil wedge which separates the tooth surfaces of involute spur gears. An equation was developed for load-carrying capacity that should prove a useful guide for gear designers.

A method of determining the operating temperature of air-cooled and water-cooled bearings was outlined in a paper by R. A. Baudry, of the Westinghouse Electric & Mfg. Co. It was shown that at high temperatures the performance of ring-lubricated bearings tends to become unstable. The design features of high-speed water-cooled and forced ventilation bearings were outlined.

\* \* \*

### ***Greenfield Tap & Die Purchases Geometric Tool Co.***

The Greenfield Tap & Die Corporation, Greenfield, Mass., has purchased the Geometric Tool Co., New Haven, Conn. The acquisition of the Geometric Tool Co. will round out the threading tool lines of the Greenfield organization and will enable that company to furnish the type of thread cutting tool required or best adapted for any job involving threaded parts.

The Greenfield Tap & Die Corporation was organized in 1912 by bringing into a single producing and distributing unit several well-known manufacturers of taps, dies, screw plates, and gages. The Geometric Tool Co. was organized in 1893 and is well known as a manufacturer of self-opening die-heads, chasers, collapsing and adjustable taps, chaser grinding fixtures, and threading machines.

The Geometric Tool Co. will operate in New Haven as a division of the Greenfield Tap & Die Corporation, with Albert S. Redway continuing in the capacity of executive vice-president and general manager. James W. Hook, former president of the Geometric Tool Co., will serve in an important advisory capacity.

# War Production and Reconversion Problems Discussed by Manufacturers

THE War Production and Reconversion Congress of American Industry, held in New York early in December under the auspices of the National Association of Manufacturers, was attended by well over three thousand executives from every part of the country. The program covered many phases of war production, labor relations, the employment of veterans, and post-war problems.

At the opening session, two addresses, one by Lieutenant-General B. Somervell—"More Production for All Fronts"—and one by J. A. Krug, chairman of the War Production Board—"W.P.B. Sets New Goals"—emphasized the import-

ance of continued and increased production of many of the critical war materials now being used in the campaigns both in Europe and in the Pacific to an ever increasing extent. A warning note was sounded not to adopt the attitude that the war is over or the victory won. From the manufacturers' point of view, a similar emphasis was made by C. E. Wilson, president, General Motors Corporation, in his address "Victory First—Then Reconversion."

The president of the Association, Robert M. Gaylord, president of the Ingersoll Milling Machine Co., Rockford, Ill., in an outstanding address dealt with many subjects bearing upon present and post-war problems. Speaking on the future of free enterprise in the post-war world, he said that it is quite probable that, when we come out of this war, America will be an island of free enterprise in a world of collectivistic governments. Government control and enterprise is growing everywhere because soft thinking, the desire for protection, and the willingness to tolerate controls in the name of adjustment, reconversion, and rehabilitation are all too prevalent.

On the subject of foreign trade after the war, Mr. Gaylord had this to say: "In our anxiety for production, we must not be enticed by talk of merely 'increasing purchasing power' by greatly



Ira Mosher, Newly Elected President of the National Association of Manufacturers

expanding foreign trade. Here we must be intensely realistic. Foreign trade means both exports and imports. All want exports, but these will have to be balanced with imports which can help to make our American life more enjoyable.

"If we give long-term credits, and we undoubtedly will, they must eventually be paid for by imports. Giving away the products of American labor and management to foreign countries in order to increase 'purchasing power' is nothing more than international make-work and is as foolhardy as domestic boondoggling. The important question is: Will we receive goods or services in re-

turn? A neighbor who borrows and does not expect to repay is just as undesirable whether he lives across the street or across the ocean."

## *The Problems of Reconversion Require Straight Thinking*

"Realistic thinking," said Mr. Gaylord, "will help us in considering reconversion. By reconversion we do not mean simply the moving out of one set of machines and the installation of another. Reconversion problems include taking care of veterans, and particularly the disabled men, so that they may again become productive citizens. They include readjustment of business to sound peacetime activities, the resumption of old services, and the creation of new ones. Of course there will be delays and difficulties, but the same brains, the same willingness, and the same ability that converted our peacetime activities to the present stupendous war production are available and are capable of doing the job.

"Our greatest pitfall will be wishful thinking. The national income is the result of the enterprise of thousands of independent individuals, but national income is not simply a stream of water coming from a tap, so that all that each individual has to do is stand by, tin cup in hand, to get his share.

"Let us look at the facts. In 1929, forty-eight million people in this country worked a little more than forty-eight hours a week, and there were virtually none unemployed; that amount of labor produced a national income of \$83,000,000,000. Recently, however, labor was told at one of its conventions that we can have sixty million jobs at forty hours a week and produce \$200,000,000,000 of national income. Now that is only 4 per cent more hours in total than in 1929, but 240 per cent more national income.

"Let us think straight. Are we talking of 200,000,000,000 real dollars or of 50-cent dollars? If we are to produce a national income of 200,000,000,000 real dollars, we shall have to buy and build production facilities far more efficient than we have now. This will take time, thrift, investment, and hard work. Everybody is for a \$200,000,000,000 national income—but it will not be realized by wishful thinking. It will take enterprise, skill, and work."

#### ***Cooperation with Governmental Authorities***

Mr. Gaylord emphasized the necessity of manufacturers working with representatives of the Government—with their Congressmen, Senators, and Administrative officials. "In the years ahead," he said, "we are going to have more Government control than before the war. Whether that control is for the better or worse will depend in a large measure, perhaps primarily, upon the kind of intelligent cooperation we manufacturers give to Congressmen and to the Administration.

"To make progress, we must cooperate and work with the Government. By this I do not mean that business men should sit by timidly and acquiesce in the whims and fancies of irresponsible administrators. Just as it is our duty to comply fully with the letter and the spirit of the law, so it is our responsibility to resist interpretations and rulings which go beyond the law."

#### ***Most Manufacturing Business is Not "Big Business"***

The speaker pointed out that, contrary to popular conceptions, most manufacturing enterprises in this country do not come under the classification "Big Business." Over 70 per cent of all labor employed in manufacturing, works in shops employing less than five hundred workers; and these shops turn out 75 per cent of the fabricated goods of the nation. In the distribution and service industries, the percentage of smaller businesses is even higher.

It is the small and medium-size business, not Big Business, that most keenly feels the effect of Big Government. Yet it is the small and medium-size business which is the backbone of

the individual enterprise system. On the executives in these businesses rests the responsibility of bringing their experience to the attention of Congress and of the Administration. Their combined voices will be heard, and their judgment and representation can be made effective.

The speaker also warned that the present tendency to have the Government finance small privately owned enterprises is to invite Government control. "The more the small and medium-size business man of this country," said the speaker, "has to look to Government when making decisions in the conduct of his enterprise, the more he is in danger of having those decisions vetoed by Government servants, and the fainter is the hope for free enterprise."

#### ***Cooperation between Management and Labor is Stressed***

One session was devoted to two thought-provoking addresses—one by William Green, president of the American Federation of Labor, on "If I Were an Industrial Manager," and the other by H. W. Prentis, Jr., president of the Armstrong Cork Co., entitled "If I Were a Labor Leader." Both emphasized the importance of a cooperative rather than an antagonistic spirit between manufacturing executives and labor leaders, between management and employees. Mr. Green further emphasized that the philosophy which has been advanced by some—that labor should have a hand in the actual management of an enterprise—should not be accepted. "It is contradictory," he said, "of American traditions and of our free enterprise system."

Mr. Prentis pointed out that the duties and responsibilities of labor leaders could be broken down into four parts—first, in respect to the union members themselves; second, in respect to employers; third, in respect to the general public; and fourth, in respect to Government.

He stressed the fact that those who receive grants of power from the Government in any field of human activity must also accept commensurate responsibility for their acts. Just as officers of corporations, and the corporations themselves, are responsible for their acts, so must labor leaders and unions assume a similar responsibility for their acts. He also emphasized the necessity for educating the rank and file in the basic concepts on which the time-honored American freedoms rest. When freedom of enterprise disappears, labor union freedom will soon disappear also, as it has in several European countries.

As to the employer, Mr. Prentis said that he would preach, in season and out, the community of interest between organized labor and business generally, and between individual unions and local management in particular; and he advised both management and labor to approach their

mutual problems in the spirit of what he preferred to call "collective negotiation" rather than "collective bargaining."

He pointed out that public opinion polls have shown that the overwhelming majority of the American people are opposed to the closed shop, compulsory union membership, and the check-off. He pointed out that compulsory arbitration of labor disputes in times of peace is contrary to the best interests of both employers and employees, because if the Government assumes the power to fix wages through compulsory arbitration, it must also control prices in order to protect the public interest. Thus, compulsory arbitration leads straight to some form of Government dictatorship and eventually to the loss of hard-won liberties.

With regard to relations with the Government, the speaker said the true interests of manufacturers and labor were alike. The function of Government in labor relations is: First, the Government fixes the rules; second, it administers them efficiently; and third, it functions only as an umpire, never as a czar.

At the meeting, Ira Mosher, president of the Russell Harrington Cutlery Co., Southbridge, Mass., was elected president of the Association, succeeding Robert M. Gaylord, who was elected chairman of the board of directors.

\* \* \*

### Preventing Accident and Fires Caused by Oil-Soaked Floors

Two floor cleaning products, known as "Speedi-Dri" and "Sol-Speedi-Dri," which are made by the Refiner's Lubricating Co., 601 W. 26th St., New York 1, N. Y., are now used by many concerns for preventing slipping accidents and fires caused by oil-soaked floors. These two products quickly absorb grease and oil from any kind of floor, somewhat in the manner in which a blotter soaks up ink.

As soon as these products are spread on the floor, they immediately provide anti-skid protection; and repeated spreading will actually restore the floor to its original color. "Speedi-Dri" is intended for use on mineral-oil soaked floors. "Sol-Speedi-Dri," on the other hand, may be used in an industrial plant to soak up soluble oils, oil and water accumulations, paints, resins, etc.

\* \* \*

The use of hard chromium plating on molds for plastic products offers many advantages. According to *Modern Plastics*, chromium-plated molds do not adhere to the moldings, their surfaces are harder, they do not mar readily, and, obviously, they wear longer.

## A Definition of Free Enterprise

The following definition of free enterprise is credited to J. Hudson Huffard, vice-president of the Kiwanis International. Says Mr. Huffard:

"Free enterprise means freedom for every individual to exert his utmost capacity in producing those commodities and services which people need.

"It means equal opportunity and freedom for every worker to choose where he will work and what he will do, without asking the consent of any bureaucrat or paying tribute to any vested interest.

"It means a system of rewards, profits and losses, arrived at through voluntary agreement in competitive markets.

"It means protection by law and public opinion against predatory practices, fraud, and violence.

"It means good sportsmanship on the part of participants, who will try to win by superior efficiency and service, not by racketeering, political favoritism, or monopolistic combinations.

"It is men and women working out their common destiny, not under the lash of coercive authority, but under the discipline of enlightened self-interest and moral responsibility."

To the sentence "It means equal opportunity and freedom for every worker to choose where he will work and what he will do . . ." should be added "It means the right and freedom of every man who creates jobs for others to decide whom he shall employ and whom he does not wish to retain in his employ."

\* \* \*

### Anti-Friction Bearing Maintenance

A useful manual entitled "Anti-Friction Bearing Maintenance" has been compiled by the Engineering Committees of the Anti-Friction Bearing Manufacturers Association, Inc., 60 E. 42nd St., New York 17, N. Y. The purpose of this manual is to meet the widespread demand for the conservation of bearings and to assist repair men to accomplish this purpose, as well as to provide information on the general handling and care of bearings.

By following the instructions given in this manual, new bearings will be protected from damage and used bearings in good condition can be removed from worn-out equipment, properly cleaned, and installed in other equipment for further use. The instructions cover the types of bearings in most general use. Specific instructions on specialized types are given in the technical manuals issued by bearing manufacturers.

The new manual—"AFBMA-100"—may be obtained from Ball and Roller Bearing Information Center, 16 E. 48th St., New York 17, N. Y.

# Checking Aircraft Assembling Jigs by Optical-Mechanical Means

**L**ARGE assembly jigs and fixtures used in the production of aircraft must have their dimensional accuracy in various planes checked periodically to insure the maintenance of the high degree of accuracy required. The provision of means for making the necessary check-ups quickly without interfering unduly with production schedules is, perhaps, the most difficult problem encountered in the application of jigs and fixtures of this kind.

The checking of alignment and linear dimensions by means of optical equipment and micrometer trammels, as outlined in this article, presents a satisfactory solution to the problem of checking, as well as setting up, large assembling jigs of the type referred to.

The equipment employed comprises a sighting telescope; a collimator; sighting targets; micrometer trammels; and an inclinometer or spirit level. The sighting telescope used is of the form shown diagrammatically in Fig. 1. An image of the object under observation is focussed in the plane of graticule A by moving lens F through knob D and rack E. When knob D is turned in a clockwise direction to a stop, the telescope is focussed on infinity, and is used in this position for the measurement of tilt. When used with the collimator, an image of the collimator graticule is formed in the plane of graticule A.

For observation of displacement, an image of a scale carried by the collimator unit is formed at A by moving lens F forward by means of knob D. Graticule A and the superimposed images are observed by the microscope system B and C. The final image is not invert-

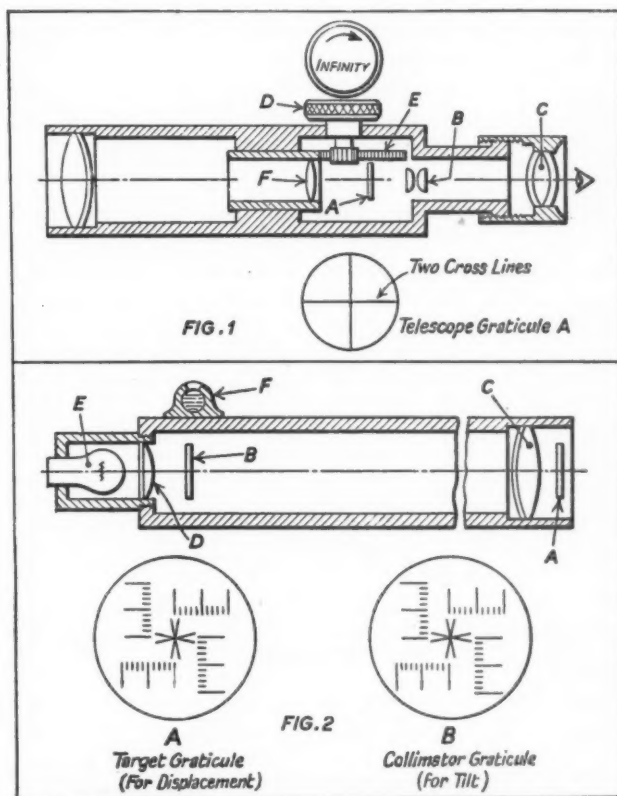
ed, so that the apparent and real displacements of the object from the telescope axis are in the same direction. For example, in Fig. 4, the displacement is shown as 0.100 inch, and by moving the collimator downward 0.100 inch, true alignment with the telescope axis will be obtained.

The telescope graticule A, shown in Fig. 1, carries two cross-lines at right angles to each other, their point of intersection being accurately positioned on the true axis of the telescope. The eye-piece C can be focussed upon graticule A to suit individual observers. The telescope is specially constructed so that its mechanical and optical axes are coincident within very fine limits. This can be demonstrated by focussing on any fixed object and rotating the telescope in its bearing, when the object will appear stationary with respect to the center of the telescope graticule A.

The collimator is, in effect, a light straight-edge. It is constructed as shown diagrammatically in Fig. 2. A graticule B is mounted in the focal plane of the collimator lens C, so that light leaves this lens in a parallel beam. The light is then said to be collimated, and graticule B is virtually at infinity.

Illumination is provided by means of a 12-volt 4-watt automobile tail-lamp bulb E. A diffusing disk and condensing lens D insure even intensity of illumination. A transformer is also provided, so that the current supply for illumination can be taken from the electric lines, if desired.

Graticule B is graduated as shown in the enlarged view, Fig. 2. The graduations consist of a central star, accu-



Figs. 1 and 2. Diagrams Illustrating the Construction of the Sighting Telescope and Collimator Used in Checking Aircraft Assembling Jigs

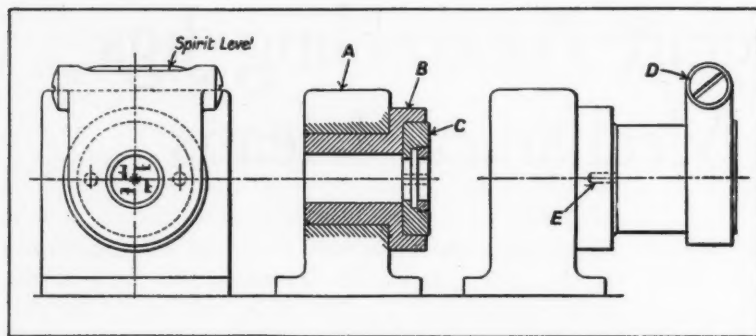


Fig. 5. Method of Setting and Holding Target Graticule for Optical Checking. An Adapter is Used to Align the Target Graduations with the Telescope Cross-hairs

ately positioned on the axis of the collimator, and scales arranged symmetrically about it. Each small division generally represents an angular displacement of one minute of arc. The construction of the collimator unit is similar to that of the telescope as regards the accurate coincidence of the mechanical and optical axes.

Fig. 3 shows how the image of *B*, Fig. 2, is formed in the telescope when the latter is set up to view the collimator and the axes of the units are inclined. The telescope lens *F* and the large lens at the left of the diagram Fig. 1, are represented, for simplicity, by the single lens *Z*, the telescope being focussed for infinity. Light rays from the central point of *B* leave the collimator lens in a beam parallel to the collimator axis, and enter lens *Z* inclined at an angle *L* to the telescope axis. These rays are brought to a focus at point *Y*, displaced from the telescope axis.

Displacement *X-Y* is proportional to angle *L*, and is independent of the distance between the collimator and the telescope. This image displacement is also independent of lateral displacement between the axes, although it will be realized that the displacement must not be so great that the beam of light from the collimator fails to enter lens *Z*. This also applies when considering the tilt and separation of the units. The whole of *B*, Fig. 2, is imaged in the plane of *A*, Fig. 1, symmetrically disposed about point *Y*.

For the measurement of displacement, the collimator carries a sighting target *A*, Fig. 2,

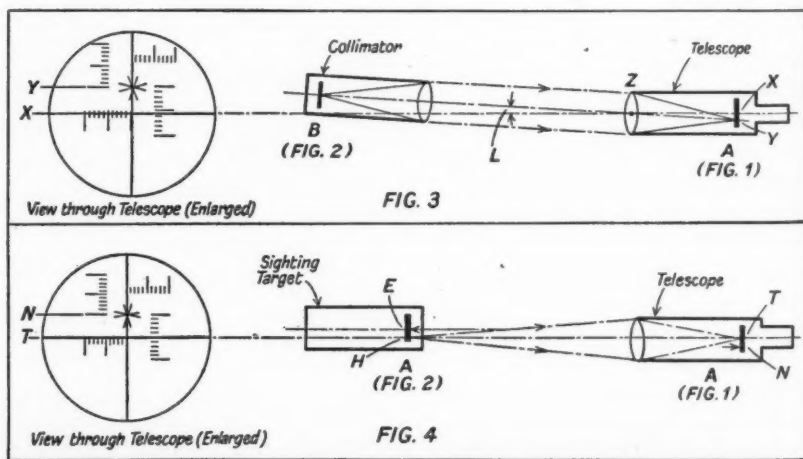
which is mounted in front of collimator lens *C* and illuminated by the beam of light emerging from it. This target is also shown enlarged in Fig. 2. It is similar to graticule *B*, but the units are in inches, each small division representing 0.020 inch. This target is so mounted that the central star is accurately positioned on the collimator axis.

Graticules *A* and *B* are mounted with the same orientation, and the collimator carries a spirit level *F*. When the level bubble is set to the zero mark, each graticule has one series of divisions horizontal and one series vertical. This enables systematic observations of displacement and tilt to be made in two meridians at right angles.

On the left in Fig. 3 is shown, enlarged, the effect observed through the telescope when the tilt *X-Y* is 5 1/2 minutes of arc in one direction with no tilt on the other axis. The telescope is set to infinity, as described in connection with Fig. 1, and it may be repeated that the image observed is direct and not inverted or reversed.

The sighting target *C* is also mounted separately in a target plug *B*, as seen in Fig. 5, with the central star on the plug axis, for the purpose of making displacement measurements only. A number of these plugs may be used for setting a series of bearings *A* in the same plane. They must be illuminated from behind, and this may be conveniently effected by means of a small hand lamp. The plug has holes at *E* such that

Fig. 3. Method of Measuring Tilt with the Collimator and Telescope. Fig. 4. Method of Measuring Displacement with the Telescope and Sighting Target



the line joining their centers is parallel to one set of divisions on graticule *C*. A setting adapter *D* is provided which engages with the two holes *E*, and has a spirit level on the top, so mounted with respect to the pins that the sighting target scales may be set in either a vertical or a horizontal position as desired.

The principle of the use of the sighting target, whether carried by the collimator unit or the target plug, will be understood from Fig. 4. The target is displaced from the telescope axis, so that point *H* now lies on this axis. The telescope is focussed on *A*, Fig. 2, by turning the knurled knob *D*, Fig. 1, and an image of *H*, Fig. 4, is formed at *T*, coincident with the central mark of *A*, Fig. 1, while the image of the center point *E*, Fig. 4, of *A*, Fig. 2, is located at *N*. Thus, *T-N* is a measure of the lateral displacement *E-H* of the axis and is independent of any inclination of the axes.

The magnitude of *T-N*, however, is inversely proportional to the separation between the units, and for this reason, the actual scale is placed at *A*, Fig. 2, and its image compared with a simple cross at *A*, Fig. 1. If displacement *E-H* is equal to one division on the scale *A*, Fig. 2, then the image displacement *T-N* will always appear as one division, whatever the separation of the telescope and sighting target; but as the distance between them is increased, the size of this imaged division will decrease. Thus, lateral displacement is always measured directly, but the sensitivity of measurement decreases with increase of separation between the telescope and the sighting target.

On the left in Fig. 4 is shown, enlarged, the view observed through the telescope. The displacement *T-N* is 0.1 inch (0.02-inch divisions) and there is no displacement on the other axis.

The chart Fig. 7 gives the sequence of operations when using the optical equipment. Here *C* is the target-holder to suit location *B* to be checked, and *E* is a graticule with graduations of a type similar to *A*, Fig. 2. For checking the

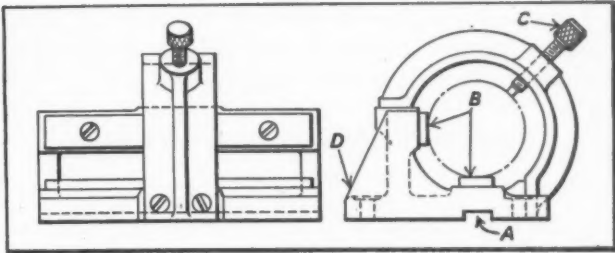


Fig. 6. Optical Bracket for Mounting Equipment on Jigs

alignment of the intermediate bracket *B*, the telescope and collimator are first aligned both for tilt and displacement. Next, the graticule is fitted in target-holder *C* in the jig and the graduations are aligned, as shown in Fig. 5. The telescope is then focussed to distance *D*, and finally, the displacement of the graticule relative to the telescope cross-lines is read off. The procedure is then repeated for the other locations.

The micrometer trammels consist of 16-inch screwed extension pieces, which can be built up to the desired length. These trammels have been used up to a length of 40 feet with satisfactory results.

The telescope and all the accessories have been constructed to withstand shock and wear in the work-shop! The telescope and collimator appear as hardened and ground tubes with an external diameter of 2.2495 to 2.2498 inches, and the external diameter of the target plug is 1.4990 to 1.4995 inches. The methods of mounting the units, of course, depend upon the job being checked.

The limits of accuracy obtainable with this equipment are as follows:

**Tilt**—Can be read to one-fifth of a division, or 12 seconds of arc.

**Displacement**—Can be read to one-fourth of a division at 20 feet (0.005 inch) decreasing to one division at 80 feet (0.020 inch).

**Distance**—The telescope focal range is from 2 to 80 feet in still air.

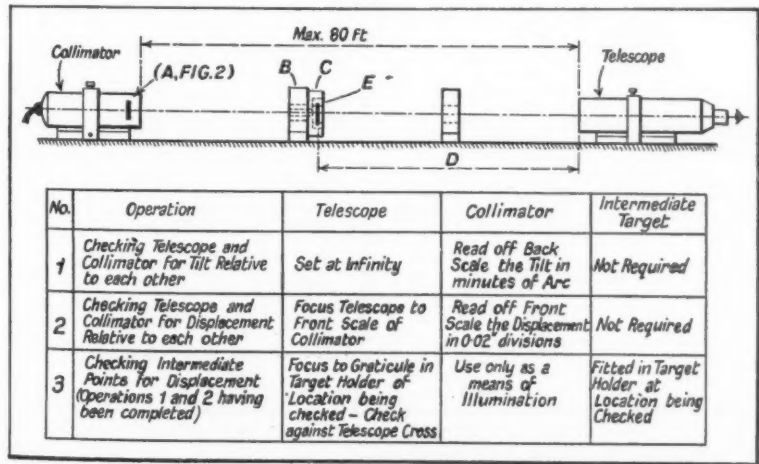


Fig. 7. Chart Giving the Sequence of Operations for Checking a Series of Locations Normally in Line

**Trammel**—Within 0.005 inch for each 20 feet. Some typical applications of the equipment are described in the following:

### Procedure in Checking Aileron Assembly Jig

Referring to Fig. 8, the periodical checking of jigs involves the following: (a) Checking the hinge-hole alignment optically, using the sighting telescope, collimator, and target bushings  $T_1$ ,  $T_2$ , and  $T_3$ ; (b) checking the centers with special slip pieces and pins used in conjunction with the Johansson trammels; (c) checking maximum contour of aileron nose locations with plate gages, as shown, and a "Go" and "Not Go" slip piece.

Standard optical brackets  $D$ , as shown in Fig. 6, are mounted on each end of the jig on machined platforms for performing the checking operation indicated by diagram  $a$ , Fig. 8. They are located by permanent tenons on the jig at each end, which engage slots  $A$ , and are secured by four hold-down bolts. The alignment of these tenons must be within 0.0005 inch in 24 inches. When the equipment is removed from the jig after checking, cast-iron "keepers" are fastened over the optical brackets to protect the location faces and the tenons. This applies to all jigs on which the optical apparatus is used.

Having fixed the optical brackets in position, the collimator and sighting telescope are mounted and secured by the brass screw  $C$ , Fig. 6, against the hardened locating slips  $B$ . The procedure in checking is as follows:

**First Check**—Turn the knurled knob of the telescope clockwise to its stop. This sets the telescope to infinity, and the amount of tilt, if there is any, between the telescope and colli-

mator can be read off the scale directly, as shown in Fig. 3.

**Second Check**—Turn the knurled knob of the telescope slowly anti-clockwise until it focusses on the front scale of the collimator, and read off directly the actual displacement, if any, between the collimator and the telescope, as shown in Fig. 4.

These two checks should record zero before proceeding with further checks.

**Third Check**—Place the target bushing  $T_2$ , Fig. 8, in location  $V$  and focus the telescope on  $T_2$  by means of the knurled knob as before. A small hand lamp can be placed behind the target bushing for illumination, although during daylight a piece of white paper is sufficient. Read off the displacement of location  $V$ , if any, as shown in Fig. 8.

**Fourth Check**—Place target bushing  $T_2$  in location  $W$  and focus the telescope on  $T_2$ . Repeat operations outlined for Check 3.

**Fifth Check**—Place target bushing  $T_2$  in location  $X$  and focus the telescope on  $T_2$ . Repeat procedure followed in Check 3.

**Sixth Check**—Place target bushing  $T_1$  in location  $Y$  and focus the telescope on  $T_1$ . The illumination of the collimator can be used to replace the hand lamp mentioned in Check 3. Read off the displacement of location  $Y$ , if any.

**Seventh Check**—In checking location  $Z$ , it will be necessary to reverse the positions of the telescope and collimator, as the telescope cannot focus to a distance of less than 2 feet from the object, and location  $Z$  would be too near the telescope in the position used for Checks 1 to 6.

Place target bushing  $T_3$  in location  $Z$ , and with the collimator and the telescope reversed, focus the telescope on  $T_3$ ; then follow the same procedure as in Check 6.

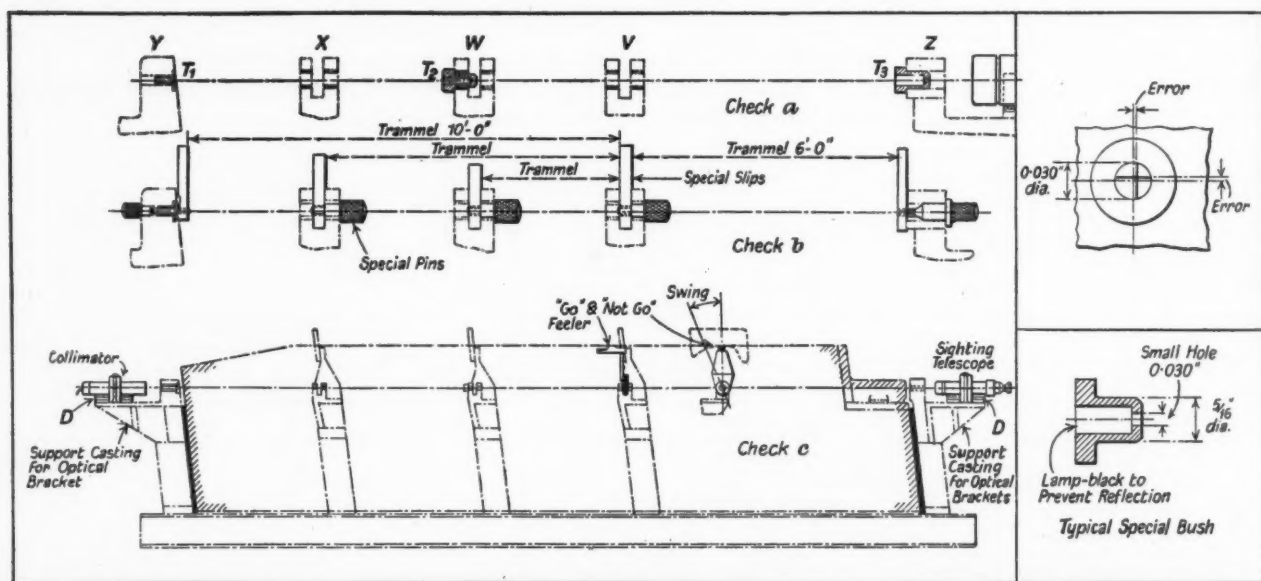


Fig. 8. Method of Checking an Aileron Assembly Jig

Owing to the small size of the holes in the jigs, the special target bushings  $T_1$ ,  $T_2$ , and  $T_3$  are used; but if the holes are above  $3/8$  inch, it is advisable to use the graduated optical target, as shown in Fig. 5. In Fig. 8 is shown a typical reading when a hole less than  $3/8$  inch in diameter is being checked, and the construction of the special bushing is also indicated.

Special hardened and ground slips are placed in position, as shown, and secured with special pins, carrying out the checking operation indicated at  $b$ , Fig. 8. Direct readings are taken with the Johansson trammels by building the trammels up to the desired length with 16-inch extension pieces.

In performing the checking operation indicated at  $c$ , Fig. 8, the trammel slips are removed and replaced by swing-gage plates in the hinge positions, as shown. The swing-gage plate at each hinge position is provided with a "Go" and "Not Go" feeler to check the maximum and minimum nose clearance of the component.

#### Method of Checking a Tail-Plane Jig

In Fig. 9 is shown the method of applying the optical-mechanical checking process to a tail-plane assembly jig. Check  $a$  is carried out to test the alignment of the hinge holes by methods similar to those described for the aileron assembly jig, Fig. 8. In this case, as the hinge-attachment holes are larger, graduated target graticules can be used in holders made to suit the jig. The procedure is the same as before, taking each hinge individually and focussing to suit.

Displacement readings of the hinges will be as indicated in Fig. 4, and relative tilt between collimator and telescope will be shown

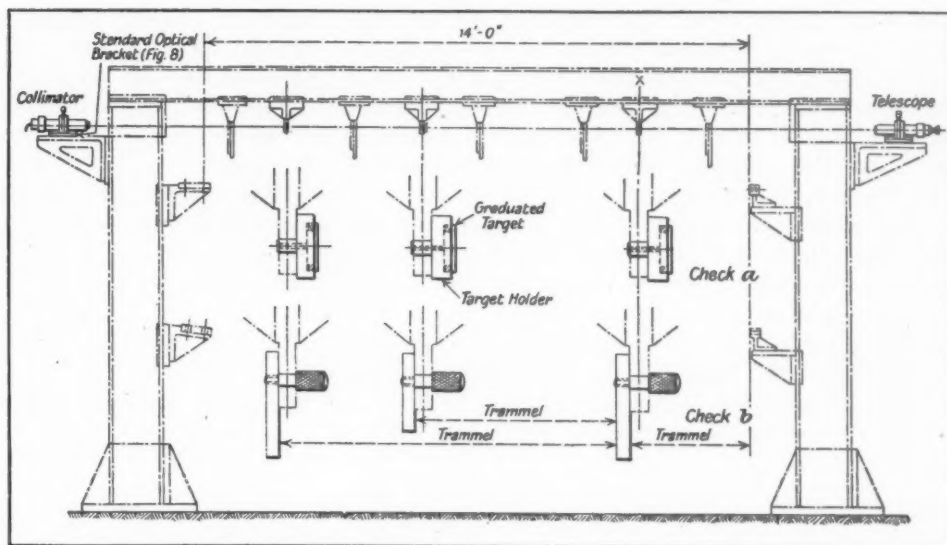


Fig. 9. Method of Checking a Tail-plane Jig

as in Fig. 3. As the first hinge  $X$  is more than 2 feet from the telescope, it is not necessary to reverse the positions of the telescope and collimator for any of the hinge checks. Check  $b$  is a straightforward trammel check with the Johansson trammels, as previously described. The checking of the shroud clearances for the elevator is similar to that of the aileron assembly jig, using swing-plate gages, and is not shown in the illustration.

Fig. 10 shows yet another application to a considerably longer assembly jig, using the small target bushings instead of the graduated target because of the small-sized hinge holes.

#### Method of Locating and Aligning Four Columns of Large Jig

In Fig. 11 is shown a different type of assembly jig requiring four jig columns to be accurately set 40 feet apart in one direction and 10

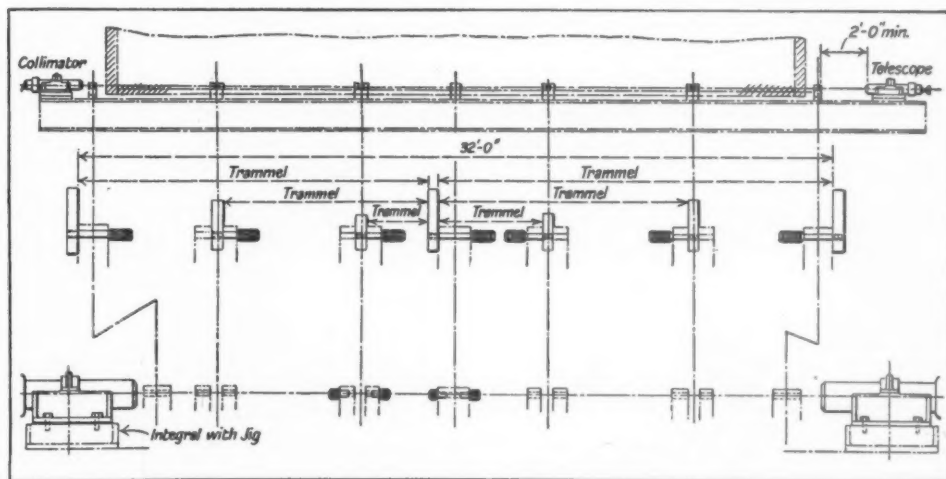


Fig. 10. Diagram Showing Method of Testing a Jig 32 Feet Long

feet apart in the other. Into each of the columns *A*, *B*, *C*, and *D* is fitted a reference piece, as indicated at *E*, which is secured by pins *F*. These reference pieces carry optical brackets *G* similar to that shown in Fig. 6. The optical brackets are used for locating the sighting telescope *H* and the collimator unit *J*.

The step-by-step operations in locating the four columns are as follows: (1) Column *A* is secured to the floor after leveling up face *L* with an inclinometer or spirit level; (2) column *B* is now placed in approximate position; (3) telescope *H* and collimator *J* are placed in position on optical brackets *G*; (4) column *B* is set for a 10-foot distance by means of Johansson trammels; (5) column *B* is now corrected for displacement and tilt, as already described in connection with the checking of the aileron assembly jig. When the readings on both scales of the collimator register zero against the telescope cross-lines, column *B* is correctly set and is secured in position. (6) Change the telescope to column *B* and the collimator to column *C*. Set column *C* with the Johansson trammels for the 40-foot dimension. Take the telescope and collimator readings for displacement and tilt as in the case of Operation 5, and correct column *C* to read zero on both scales of the collimator. Secure jig column *C* in position. (7) Change the telescope to column *C* and the collimator to column *D*. Set column *D* with Johansson trammels for the 10-foot dimension to column *C*, and the 40-foot dimension to column *A*. Take the telescope and collimator readings as in Operation 6, and correct column *D* until the zero reading is obtained. Secure jig column *D* in position. (8) As a final check, place the telescope on column *D*, and the collimator on col-

umn *A*. The readings on both collimator scales should then be zero. The readings for displacement and tilt of any two adjacent columns should be zero. Remove the four reference pieces from the four jig columns and the jig is ready for use.

The four examples of assembly-jig checking described in this article give a good idea of the possibilities of the telescope and collimator for this kind of work.

\* \* \*

## Western Society of Engineers Celebrates Seventy-Fifth Anniversary

On December 5, the Western Society of Engineers celebrated the seventy-fifth anniversary of its founding with a dinner at the Sherman Hotel, Chicago. The Society was founded in 1869, and is the third oldest engineering society in the United States. It has maintained a high professional standard throughout the years and its library deserves special mention, since it is considered one of the outstanding engineering libraries in the country. It comprises more than 23,000 volumes and pamphlets, thoroughly indexed. It is kept up to date by frequent purchases of new books.

\* \* \*

## A Spotlight as an Aid to Welders

An arc welder, before he strikes his arc, is unable to see the work through the smoked glass window of his mask under normal illumination, although the arc is so intense as to provide ample light after he has begun to weld. To enable welders to see clearly through their smoked glasses even before striking the arc, the Westinghouse Research Laboratories have developed a spotlight which casts on the work area a light twice as bright as the brightest sunlight on the seashore in the summertime. This light is intense enough for the welder to see the spot to be welded through his protective light filter. A foot-switch makes it possible to turn on the light for an instant to locate the spot where the arc should be struck. This bright beam of light is produced without creating much heat, an important point to a welder working in a small booth in hot weather.

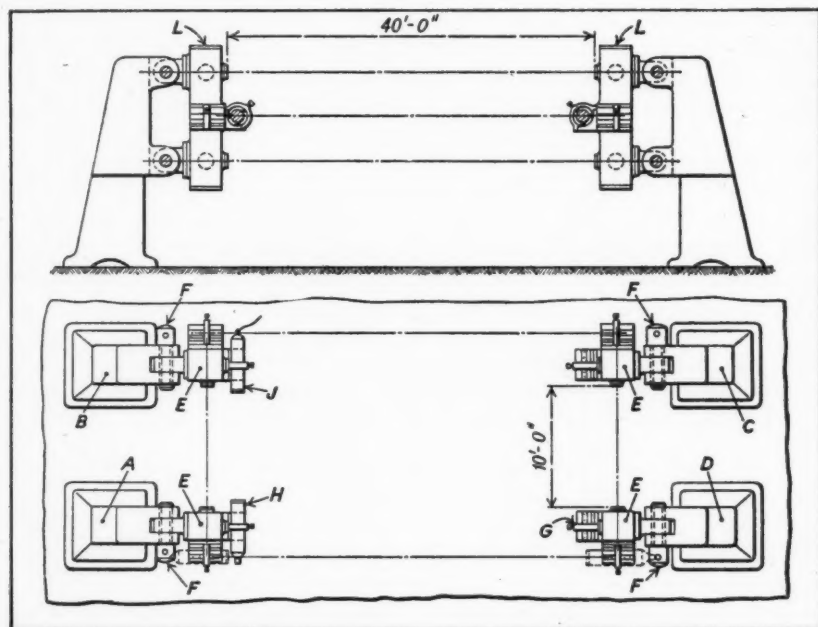


Fig. 11. Method of Locating and Aligning Four Columns of a Large Jig

# Simple Gage for Checking Pump Gears

By B. T. SMITH, Quality Control  
Westinghouse Electric & Mfg. Co.  
East Springfield, Mass.

**M**OST inspectors consider the rapid checking of gears a very difficult problem, primarily because very little has been done until recently to develop gages for this purpose. The use of special gear checking machines is not always economical, especially when only a limited number of gears are to be checked or when the manufacture of gears is not part of the normal activity of the plant. In such cases, simple gages of special design are generally to be preferred.

The accompanying illustrations show a gage for checking pump gears for thickness of tooth section, major diameter of gear, and concentricity. All three of these elements must be held within close limits to insure proper functioning of the assembled pump. Eight pump gears are located in a turret type fixture, as shown in Fig. 1, for the checking operations, which are performed as illustrated in Fig. 2. An indexing pin which enters the V-notches in the edge of the work-holding turret serves to locate each

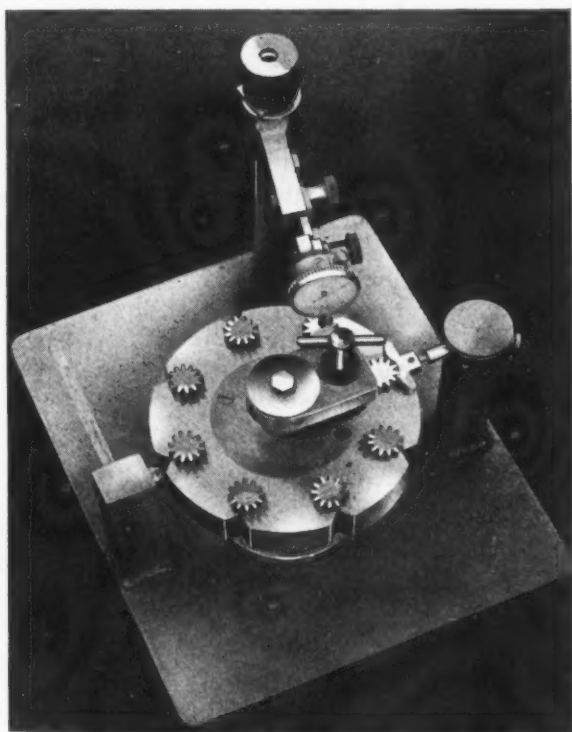


Fig. 1. Gage Designed for Checking Outside Diameter, Thickness, and Concentricity of Pump Gears



Fig. 2. Checking Pump Gears on Gage Shown in Fig. 1 by Reading Two Dial Indicators

gear in the correct positions for checking all elements.

The gears are checked for outside diameter and concentricity by means of the dial indicator at the side (Fig. 1). They are rotated for this test by the T-handle on top of the gage, which operates a master gear that engages the gear being checked. While a gear is being tested for diameter and concentricity, an adjacent gear is checked for thickness by the dial indicator seen in position above the turret.

\* \* \*

The biggest producer of war material in America is the General Motors Corporation. Yet the war activities of this organization have created a minimum of community problems in regard to housing, transportation, sanitation, schools, etc., because of the spread of the plants of the corporation geographically. Its 118 plants are located in 49 different communities throughout the United States.

# Arc-Welding Metal-Cutting Tools to Save High-Speed Steel

Methods Developed for the Maintenance of High-Speed Steel Cutting Tools and the Conservation of Tungsten Used in Their Manufacture. Abstract of an Article Entered in the James F. Lincoln Arc Welding Foundation Award Program by H. W. Rushmer, of the Jeffrey Mfg. Co.

**S**INCE tungsten is one of our most important strategic metals and is needed in larger quantities than are now available, it is essential that we make every effort to conserve it. One way to do this is to save and use as efficiently as possible every bit of high-speed steel now in our metal-working plants, as this material contains from 12 to 20 per cent tungsten.

Until recently, attempts to economize in the use of high-speed steel for metal-cutting purposes by arc-welding tips of this material to carbon-steel shanks failed because the tool steels, especially the high-alloy steels, could not be successfully arc-welded with either the coated or uncoated low-carbon steel electrodes employed. Recently, however, it has been amply demonstrated that all tool steel can be successfully arc-welded by using 18-8 stainless-steel electrodes. The methods described in this article apply primarily to the joining of SAE 1095 steel shanks or tool bodies to 18-4-1 high-speed steel tips or bits by arc-welding with 18-8 stainless-steel electrodes.

In developing the methods to be described, a test was first made which consisted of arc-welding carbon tool steel to 18-4-1 high-speed steel, the ends of the samples being ground to shape for welding. The size of the stock was 5/8 inch by 1 1/4 inches. The samples were preheated with an acetylene torch, and then welded by using 18-8 stainless-steel electrodes, which have 18 per cent chromium and 8 per cent nickel.

It is better to heat the parts to be welded in a furnace, so that the heating can be accomplished at a slower and more uniform rate. The sample, after being heated to the proper forging temperature, was forged in the central portion to cross-section dimensions of 1/2 by 1 inch, allowing the ends to retain their original size. The sample thus produced consisted of high-speed steel at one end, stainless steel at the center, and carbon tool steel at the opposite end. This sample was tested by bending it to a U shape, or an angle of 152 degrees.

Previous to this bending test, the sample was heated to the forging temperature and bent at the weld to an angle of 90 degrees, then straightened out flat again, and bent on the reverse side to U shape. This last bending test was completed without revealing any signs of fracture or opening at the weld.

In another test, a piece of carbon tool steel and a piece of 18-4-1 high-speed steel were welded together by using an 18-8 stainless steel electrode, 3/32 inch in diameter. After the welding operation, the piece was forged to a smaller size (1/2 by 1 inch) without any signs of failure in the weld. The same specimen is shown in Fig. 1 after having undergone a torsional test in which it was twisted 180 degrees without any signs of rupturing at the weld. It is well not to spread the weld over too large an area, a short weld being as strong as a long one. It also has the advantage of conserving our lim-

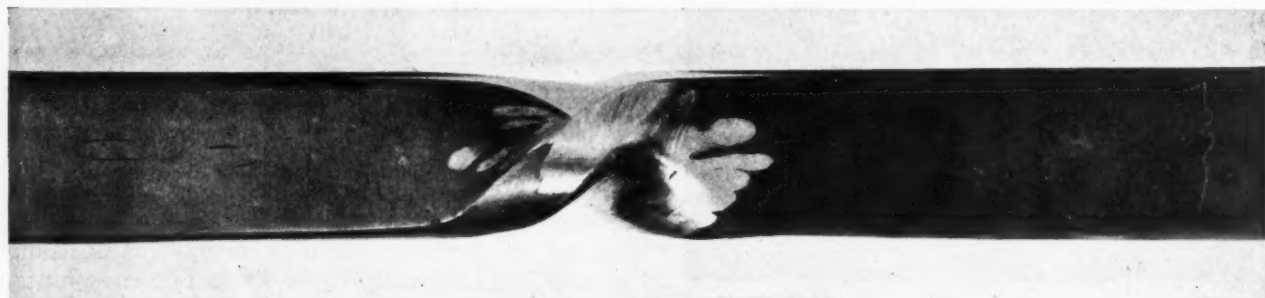
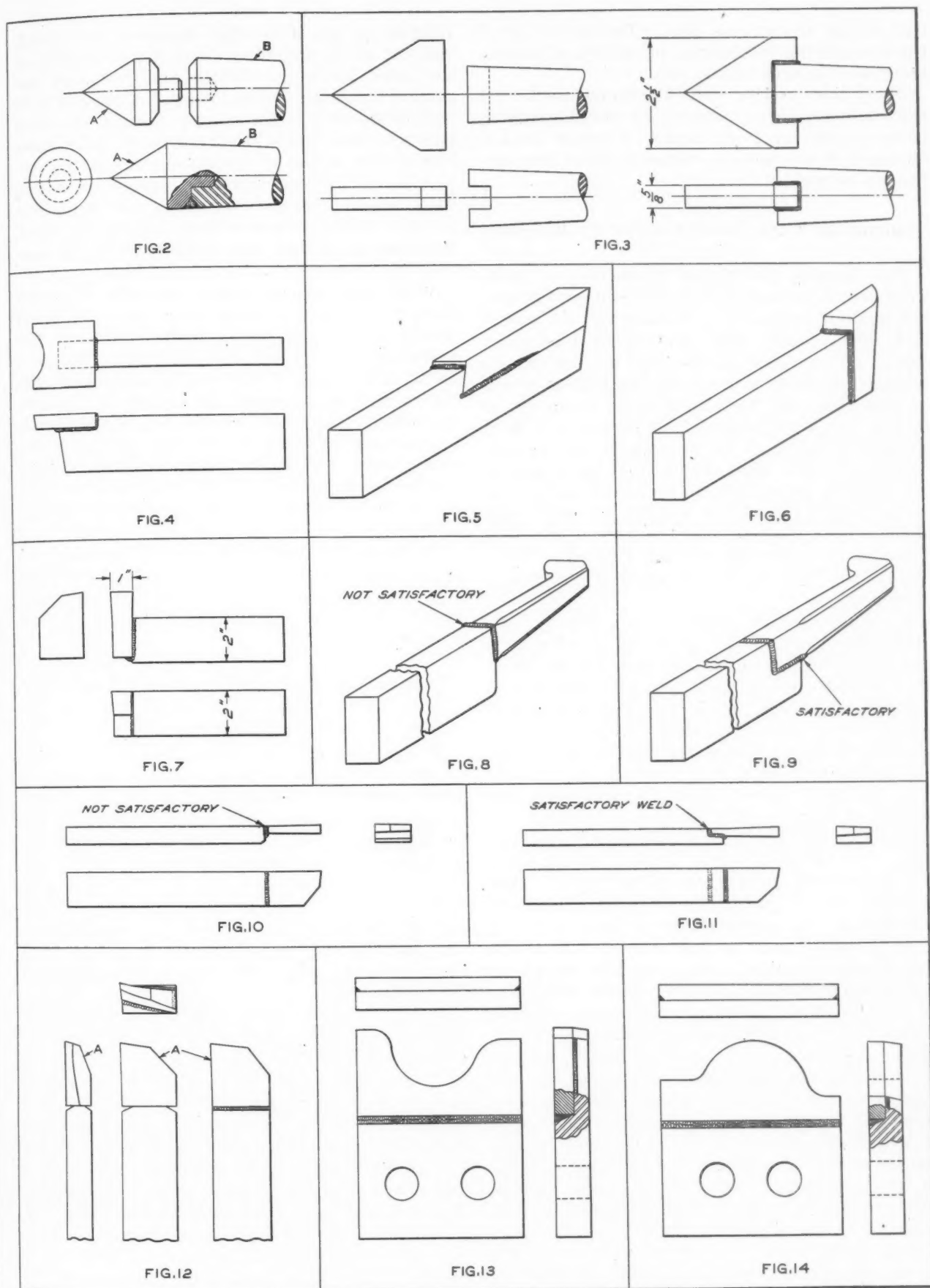


Fig. 1. Test Piece of 18-4-1 High-speed Steel Arc-welded to Carbon Tool Steel with 18-8 Stainless-steel Electrode and Twisted 180 Degrees at the Welded Joint



Figs. 2 to 14. Examples of Tools Designed to Conserve High-speed Steel by Arc-welding Tips of This Material to Carbon Tool Steel Shanks with 18-8 Stainless-steel Electrodes

ited supply of stainless steel. The stretching of the steel during the forging operation, of course, increases the area of the weld.

Many tools can be welded without machining the surfaces, either forging or rough-grinding being satisfactory. Of course, a better bond is obtained if the scale is removed from the surface to be welded.

### *Salvaging Worn Lathe Centers by Welding*

The demand for higher production on lathe work, which necessitated faster feeds and speeds, has made it necessary to replace the old carbon tool steel centers with centers of high-speed steel. The obsolete carbon-steel centers can be salvaged or made suitable for the higher speeds by annealing and then machining, as shown at *B*, Fig. 2. A high-speed steel center *A* is then applied to shank *B* by welding at the groove. Even high-speed steel centers that have become too short in length can be annealed and a new center welded on. After welding has been completed, it is important that the welded pieces be annealed to relieve the welding stresses. These centers can be annealed, reconditioned, and rehardened.

A countersink, for example, can also be made from the shank of an old drill, as shown in Fig. 3. The cost of high-speed steel for the blade used on this tool was less than \$1. The cost of the material alone, if the tool had been made entirely from high-speed steel, would have been \$6. When made as shown, the material and labor cost did not exceed \$3.

In Fig. 4 is shown a forming tool used primarily on brass work. Tools of this kind are made from both carbon tool steel and high-speed steel. The carbon tool steel holds a keener edge, giving the work a somewhat better finish. Like the tools shown in the illustrations previously referred to, the cost of making these forming tools as designed is a fraction of that of the forged and machined tools formerly employed.

Extension shanks for taps, drills, broaches, etc., can be readily welded to the shanks of these tools. The stock used for the extensions can be drill rod or low-carbon machine steel. Extensions of this kind have been used on large numbers of taps, drills, and reamers. Machine steel is usually satisfactory for extending the length of drill shanks. Even pipe taps with short shanks can be welded to extensions with good results. In welding taps, it is well to cover the threads with asbestos or a thin piece of sheet metal while performing the welding operation. This precaution is necessary to prevent the sputtering of the arc from depositing small globules of molten metal on the threads.

A high-speed steel broach shank broken at the pulling eye was satisfactorily repaired by arc

welding in the following manner: The shank was cut off by grinding about 4 inches back of the break, the temper drawn, and the cut-off end ground to a blunt conical point. A piece of 3/4-inch drill rod with the point ground in the same way was then welded to the broach. After completing the required machining work, the eye was given a spring temper. Since carbon tool steel, when properly tempered, will withstand greater pulling stresses than high-speed steel, the repaired broach was stronger in the eye section than when new.

While conventional square tool bits are satisfactory for light cutting, they may fail when taking heavy cuts at high speed due to the springing, shattering, and the lack of sufficient metal in the body of the tool to carry away the heat which is generated so rapidly at the cutting edge. The tool shown in Fig. 5 is designed to overcome this lack of sufficient metal for carrying away the heat, especially when taking heavy roughing cuts. If the contacting surfaces are perfectly level, very little welding will be required.

To prevent softening or drawing the hardness of the tool bit, the arc should not be left on the work too long in one place and the electrodes employed should not be larger than 3/32 inch in diameter.

### *Roughing Tool Designed to Conserve High-Speed Steel*

A roughing tool for lathe, shaper, or planer work can be made as shown in Fig. 6. Several other designs have been used to conserve high-speed steel, but this design has proved to be the most practical. The high-speed steel point can be forged in a swaging machine, annealed, and then cut to the desired length by a hacksaw. Old tools that have become too short for further service can be forged to meet the requirements for such points. After the welding has been completed, the points are heated and ground to shape while hot.

It is considered good practice to anneal all welded and forged tools after finishing them. The cost of high-speed steel for a 3/4- by 1 1/2-inch roughing tool is \$3.45, and the labor cost of a smith and helper is 80 cents, making a total of \$4.25 for the solid high-speed steel tool. The cost of medium carbon steel for the shank of a welded tool would be 12 cents, the cost of the high-speed steel tip 16 cents, and the labor cost 25 cents, making a total of 53 cents. Thus, the welded-tip tool represents a saving of \$3.72.

In Fig. 7 is shown a heavy side tool for a planer. Tools of this design, as originally ordered, were made of 2-inch square high-speed steel, representing a cost for the steel alone of \$61.45. The added cost of \$2.48 for the forging

operation brought the total cost to \$63.93. The cost of medium carbon steel for the shanks for welded tools of this type was \$1.91, and the cost for forging these to prepare them for welding was \$1.25. The labor cost for arc-welding the tools was \$1.25, and the cost of the high-speed steel for the points \$6.14, making a total of \$10.55 as against \$63.93 for the solid high-speed steel tools. The arc-welding practice in this case made possible a saving of \$53.38.

In Fig. 8 is shown the design of an inside threading and boring tool. In a few instances, tools made in this manner failed at the weld; but when made as shown in Fig. 9, no failure occurred. In Fig. 10 is shown a long-side cut-off tool that failed due to the fact that the weld was made in the weakest part of the tool. The design shown in Fig. 11 has the weld located in the heavier part of the tool, thus overcoming failure.

In Fig. 12 is shown a lathe side-facing tool which can be made by the arc-welding method with a considerable saving in cost and material. In Figs. 13 and 14 are shown two radii forming tools for a planer. These tools are clamped in a toolpost that is used for holding form-finish tools of various contours. Four of the tools are required for the complete planer set-up.

The cost of these tools, if made of high-speed steel, would have been \$15.70, whereas the cost, when made with tips of high-speed steel, was 50 cents for the SAE 1045 steel shanks and \$3.40 for the high-speed steel plates. The labor cost for machining the high-speed steel plates was \$3, and the cost of welding the plates to the bodies of the forming tools was \$2, making a total cost of \$8.90 for the welded tool, which represented a saving of \$6.80.

In this case, discovery that no high-speed steel stock was available prompted the use of the arc-welded type of tools. To have ordered the stock for solid high-speed steel from the mill would have delayed the work three or four weeks, whereas, by using the welded method, the tools were made available immediately, so that it was possible to send the order out in record time.

Phosphor-bronze electrodes cost less than stainless steel and can be used to good advantage in welding some tools. Tools made from high-speed steel must be forged and hardened before welding with phosphor bronze, but carbon tool steel can be hardened before or after welding.

\* \* \*

"The great fact of which the war production job has made us conscious is the amazing resourcefulness of American industry—its flexibility and its ability to adapt its experience, ingenuity, and resourcefulness to whatever problem confronts it."—Paul Garrett, vice-president, General Motors

## Principal Steps in Reconversion

In an address before the annual meeting of the National Association of Manufacturers, C. E. Wilson, president of General Motors Corporation, divided the problems of reconversion roughly into four classifications:

"First, the physical one—the job of obtaining, tooling, and installing new machinery, and disposing of machinery that is not needed; of building new plants and reconditioning old ones; and of clearing out war inventories and building up inventories needed for peace production.

"Second, the time element. Time factors are not generally understood. Too many people think that mass production can be turned on and off like water from a faucet. They are inclined to think of mass production in terms of assembly lines and to forget all the planning, paper work, engineering, purchasing, primary manufacturing, and coordination that must be accomplished before assembly lines operate.

"Third, the psychological and human relations problems. This involves the employment of veterans; new and different jobs for many people where they now live, and the migration of people, somewhat similar to that which occurred in the war products conversion period; and even more important—the teamwork and tremendous effort of the skilled men and women, mechanics, engineers, salesmen, and executives who know how to do the job. The war period will not really be over until our fighting men are all back and we have a stabilized economy with reasonably full employment. The process of changing from war to peace will require much hard work, some sacrifices, and patience and understanding.

"Fourth, the important, but less tangible thing, which we might call mental or spiritual reconversion. Pressure groups, as well as individuals, must learn how to be aggressive and ambitious without being quarrelsome and selfish."

\* \* \*

## Twenty Years of X-Ray Service

The St. John X-Ray Service, Inc., 30-20 Thomson Ave., Long Island City, N. Y., is celebrating its twentieth anniversary as an industrial service organization. During that period, this organization has pioneered many of the steps in the application of X-rays to industrial work. What is believed to be the first commercial X-ray laboratory in the world for industrial radiography was established in Long Island City in 1925, and what is believed to be the first public exhibit of industrial uses of X-rays was made at the Metal Exhibition in Chicago in 1926. From then on, the company has installed equipment in plants, developed training courses, and pioneered many X-ray developments.

# Engineering News

## "Foamglas" — A Glass Product as Light as Cork

An entirely new material, first put into commercial production less than two years ago, is now being used to such an extent that the Pittsburgh Corning Corporation is doubling its Foamglas plant capacity at Port Allegheny, Pa. Foamglas is produced in slabs of 12 by 18 inches and in various thicknesses. It is a glass that has been blown up or "cellulated," so that its volume is about fifteen times that of ordinary glass. It has a closed-cell structure, there being some five million tiny sealed air pockets in each cubic foot. Foamglas weighs 10 pounds per cubic foot, or about the same as cork.

Because of its light weight and its complete imperviousness to water, it is being used as the buoyant element in life rafts, buoys, and other flotation equipment. As insulation, it has also been employed in many types of ship construction. One of its most useful properties is that it is completely unaffected by water in any form. Obviously, it is non-combustible, is vermin- and rodent-proof, and because it will not absorb or give off odors, has a considerable application in food processing and storage plants. Being a glass product, it is not harmed by acid atmospheres or solutions that would attack many other materials. Hydrofluoric acid and hot caustic are the only chemicals that affect it adversely.

## The Vibrograph—A Mechanical Device for Recording Vibration

A simple means for recording vibration right on the spot where it develops has been brought out by the Westinghouse Electric & Mfg. Co., Pittsburgh, Pa., in the form of a device known as the "Vibrograph." In the past, the problem of recording the vibrations in some remote corner of a plant or in a building far removed from laboratory facilities was difficult to handle. Although portable vibration recorders were available, most of them were rather large and heavy and required an external source of power.

The present Vibrograph is not any larger than an ordinary box camera; it weighs less than 9 pounds, and requires no power connection. This device provides a permanent record of vibrations over a range of 600 to 15,000 cycles per minute and for amplitudes as low as 0.0001 inch or as great as 1/16 inch. The record and a timing

wave are drawn by a stylus on a transparent plastic tape only 1 inch wide.

The Vibrograph is a purely mechanical device, using the same principle by which earthquakes are recorded. It consists in the main of a frame containing a mass suspended by a weak spring. A pointer attached to the mass indicates relative motion between the frame and the mass when the frame is applied to a vibrating body.

## Chilling Aircraft Parts to Make Them "Grow"

A freezing process that causes under-sized engine parts to "grow" is now in regular use at the Ford Motor Co.'s plant at Dearborn, Mich. The new treatment, which greatly reduces waste, is being applied to under-sized articulated rod pins for aircraft engines. Experiments with other parts have yielded promising results. Ford engineers believe that ultimately this process will find widespread use.

Pins that are 0.0002 or 0.0003 inch under size are brought to the required dimensions by cooling them to a temperature of 313 degrees below zero—that is, by packing them in liquid air. The actual "growth" takes place on the outer surface of the metal subjected to the cold treatment. The process by which this is achieved involves a change in the physical properties of the austenite present in the steel. When steel is subjected to extreme heat or extreme cold, the austenite changes into martensite, a constituent that has greater bulk. Hence, the dimensions of the part treated are increased. It is stated that many thousands of pins have been salvaged through this cold treatment.

## Method of Increasing Horsepower of Aircraft Engines in Emergencies

A special water-injection device that enables fighter pilots to obtain approximately one-third additional horsepower from their engines during emergencies has recently been developed. When the pilot requires an added burst of power from his engine, he presses a button. A water regulator attached to the engine crankcase introduces a stream of water into the gas line, and a valve attached to the carburetor controls the mixture, making it leaner. Added engine efficiency is achieved by this "leaning out" of the mixture. However, a lean mixture produces

excessive heat by reducing the cooling action of excess gas inside the cylinders. The water injection overcomes this condition by keeping the cylinder temperature within the limits of operating efficiency while the engine is functioning on the lean mixture.

### Large Tanks Made from Glass Fabric Coated with Rubber

To provide the combat troops in the Pacific with an adequate supply of drinking water, a new type of water storage tank has been developed by the United States Rubber Co., Rockefeller Center, New York City. These tanks, which are 11 feet in diameter and 54 inches high, are made of a glass fabric coated with synthetic rubber. They are collapsible and can be compactly folded. The tanks are easy to transport and set up in the field, as they are mounted in a framework that is also collapsible. These glass-fabric water storage tanks are not affected by rot or mildew; they resist fungus growth, are light in weight, strong and durable, and completely water-tight. The material is non-toxic, and does not give any objectionable taste or odor to the water.

### Magnesium Airplane Wings Now Used in Training Planes

Airplane wings fabricated entirely from magnesium have been used for more than a year on Navy training planes, according to a paper by

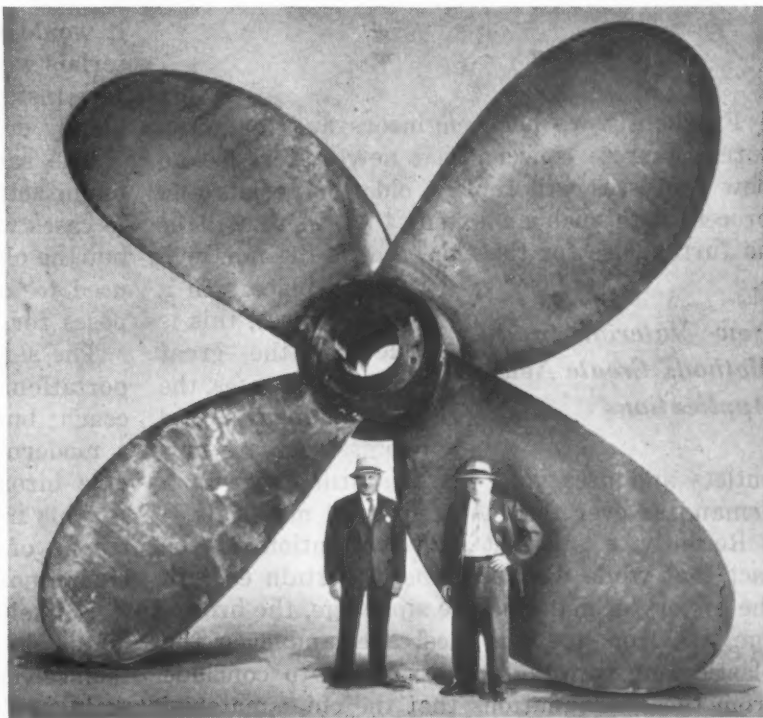
J. C. Mathes of the Dow Chemical Co., read before the recent annual meeting of the American Society of Mechanical Engineers. While the use of magnesium alloys in aircraft has increased during the war to such an extent that the average fighting plane now utilizes approximately half a ton of this metal, the adoption of all-magnesium wing structures represents a new departure in aircraft design.

The speaker expressed the opinion that the success with these wings foreshadows all-magnesium airplanes in the very near future. Since magnesium is considerably lighter than aluminum, several hundred pounds in plane weight can be saved by the utilization of magnesium, and air transport planes built from magnesium would be able to carry that many more pounds of pay load. It has been estimated that the saving of a single pound in plane weight is worth a hundred dollars a year in a commercial plane.

### Mustang Fighters Have a Speed of 450 Miles an Hour

The secrecy surrounding the world's fastest propeller-driven airplane has been lifted to the extent that the War Department has permitted North American Aviation to reveal that its P-51 Mustang fighter has a speed of 450 miles an hour. It is significant that a plane capable of 450 miles an hour in level flight is a single-engine fighter. It holds the transcontinental speed record and also holds an altitude record of over 40,000 feet, with a range of 2000 miles. It is powered by a Packard-built Rolls Royce Merlin engine.

*One of Six Manganese-bronze Ship Propellers, Believed to be the Largest of Its Type Ever Cast for Cargo Ships, as Made by the Cramp Brass & Iron Foundries Division of the Baldwin Locomotive Works. These Propellers are 22 Feet in Diameter, have 202 Square Feet of Area, and have a Finished Weight of between 65,000 and 70,000 Pounds*



# Editorial Comment

Under normal conditions, each year approximately 700,000 young men and women enter useful occupations in excess of the number of workers that drop out due to old age or death. Since it is estimated that it takes, on an average, \$5000 worth of equipment in the form of

## ***To Create Jobs, Industry Must Be Able to Invest***

buildings, machines, etc., to employ one person, it is evident that to employ these new workers, an annual investment in industry and agriculture of about \$3,500,000,000 is required.

Where are these investment dollars to come from if both industrial enterprises and individuals are so highly taxed that there is little or no surplus available for reinvestment? The importance of so handling our tax system that enough money remains available for investment to create employment for the increasing number of workers is evident.

Without ability to invest, there is no opportunity to employ. The policy of the Government, if along wise and farseeing lines, must be to assist individuals and business enterprises to accumulate a surplus that can be invested and to encourage such investment by avoiding confiscatory taxation.

Frequently we hear engineers and manufacturers express concern that new materials and new processes will replace older materials and processes to such an extent that there will be no further use for the old, because the new will

## ***New Materials and Methods Create New Applications***

take its place. In a few instances, this is true; in the great majority of cases, the new materials and processes create new

outlets and uses, and there is still as great a demand as ever for the "replaced" materials. Recently a scientist called attention to the fact that while we have labeled certain eras in the history of mankind the stone age, the bronze age, the iron age, the steel age, and even the plastic age, it would be erroneous to conclude from these designations that the chief material

of any one age was replaced by that of the following age.

"Take the stone age for example," he said. "The stone age is supposed to have passed many thousands of years ago; and yet in these United States we have used more stone for building materials and other purposes since the turn of the century than was used on this continent in all the preceding centuries. We have used more bronze during the recent war years than we ever used in any one year before, and more iron and more steel."

High-speed steel replaced carbon steel as a cutting tool material; but carbon steel and its alloys have been produced in greater quantities in recent years than ever before. Die-castings

## ***There is Usually a Place for both the New and the Old***

have taken the place of millions of screw machine parts, and yet we produce today, and even in peacetime, more screw machine parts than ever before. Plastics are coming to the front, yet it is safe to say that in the post-war years, while we will use enormous quantities of plastic materials, we will still use metals to a greater extent than in pre-war years.

Each of these new materials was developed to fill a purpose of its own. It was found that it would also fill purposes for which other materials were formerly used; but except in a very few instances, no new material has ever completely crowded out the old.

The same is true of many new methods of manufacture. These methods are being applied in cases where they are especially advantageous, but the old methods of production are still being used to an ever increasing extent for the purposes for which they are best adapted.

The same general reasoning applies to transportation. The railroads replaced the stage coach; but along came the bus, which is merely a modern stage coach that has made considerable inroads on the business of the railroads. At this moment, railroads, buses, and all other means of transportation are taxed to the extreme, none having replaced the other. And so it is likely to be in all fields of endeavor; new materials and new methods make a place for themselves, while the old ones continue to remain useful to an ever expanding degree.

# Ingenious Mechanical Movements

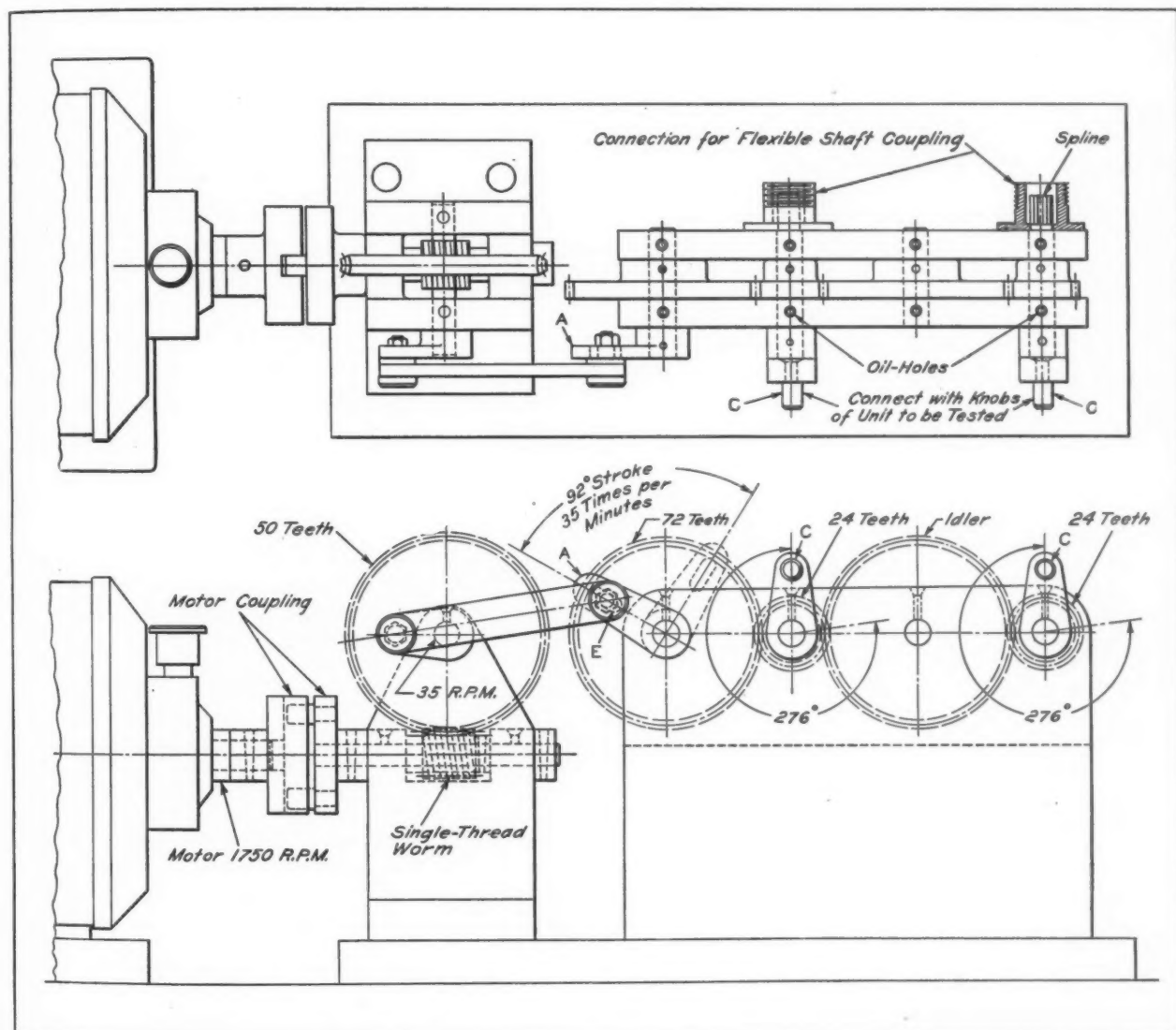
Mechanisms Selected by Experienced Machine Designers  
as Typical Examples Applicable in the Construction of  
Automatic Machines and Other Devices

## Mechanism for Determining Wearing Qualities of Electronic Equipment

By EDWARD LAY, Chief Tool Designer  
Fairchild Camera & Instrument Corporation

To assure the durability and dependability of electronic equipment furnished to our armed forces, samples or units of the equipment are tested on fixtures having actuating mechanisms

such as shown in the accompanying illustration. The units to be tested are connected to crank-pins *C* of the mechanism, which automatically duplicates field operating conditions. The mechanism thus completes in a short period of time as many operating cycles as the equipment would be subjected to in a lifetime of actual service. These tests, when continued until the unit starts to register defects, show that the units generally withstand twice the number of cycles specified.



Actuating Mechanism with Oscillating Cranks for Testing Wearing Qualities of Electronic Equipment

The fixture shown is designed to turn a pair of knobs 276 degrees clockwise and anti-clockwise thirty-five times per minute continuously for 150 hours. The ends of the turning shafts opposite the crankpin ends are threaded to fit flexible-shaft couplings for remote control testing of similar units. The electric motor employed to drive the mechanism can be easily removed without disturbing the rest of the fixture.

The design of the mechanism is simple, and its basic characteristics are such that they can be applied to various drives requiring forward and reversing movements. The mechanism is constructed primarily of cold-rolled steel, welding being used wherever possible. The worm and worm-wheel of the drive, as well as the gears, are of standard sizes, obtainable from gear manufacturers. The elongated hole *E* in the crankpin *A* facilitates adjustment for the angular stroke, which is set to rotate the cranks *C* through an angle of 276 degrees by means of the 72 to 24 ratio gearing. The fixture operates very satisfactorily, and is being used for testing many units not considered when the device was originally designed.

\* \* \*

## Measuring the Diameter of a Split Liner

By VICTOR SWIATEK

The outside diameter of a split liner for a bearing can be readily measured over pins, as shown in the accompanying diagram. The derivation of the formula for the diameter is as follows (using the notation in the diagram):

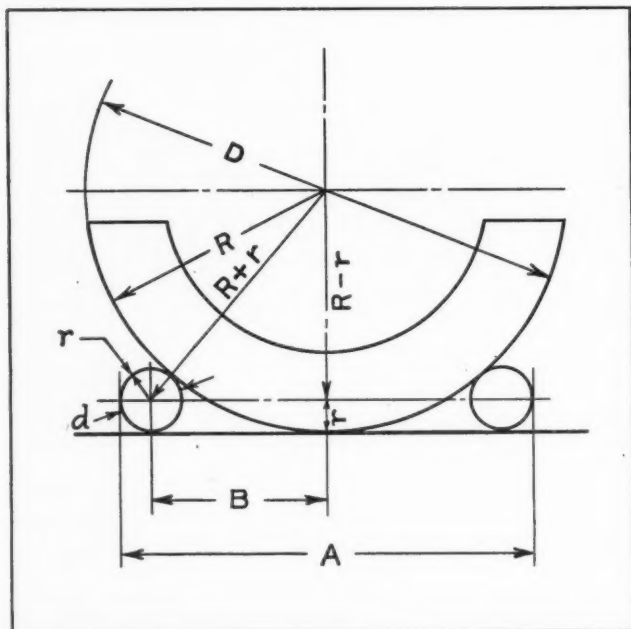


Diagram Showing Method of Using Pins for Measuring Outside Diameter of a Split Liner

*D* = outside diameter of liner;  
*R* = outside radius of liner;  
*d* = diameter of pin;  
*r* = radius of pin;  
*B* = horizontal distance between center of pin and center of liner; and  
*A* = measurement over pins.

$$(R - r)^2 + B^2 = (R + r)^2$$

$$R^2 - 2Rr + r^2 + B^2 = R^2 + 2Rr + r^2$$

Cancelling the  $R^2$  and  $r^2$  terms and combining the  $Rr$  terms, we get:

$$B^2 = 4Rr$$

Then

$$R = \frac{B^2}{4r} \text{ and } D = \frac{B^2}{2r} = \frac{B^2}{d}$$

But

$$B = \frac{A}{2} - r = \frac{A - 2r}{2} = \frac{A - d}{2}$$

Therefore

$$B^2 = \frac{(A - d)^2}{4}$$

Hence

$$D = \frac{B^2}{d} = \frac{(A - d)^2}{4d} \quad (1)$$

If pins of 1 inch diameter are used, this formula can be simplified as follows:

$$D = \frac{(A - 1)^2}{4} \quad (2)$$

Similarly, for pins of 0.5 inch diameter, the formula would be:

$$D = \frac{(A - 0.5)^2}{2} \quad (3)$$

**Example 1**—What is the diameter of a split liner if the measurement over pins of 0.460 inch diameter is 3.297 inches? Using Formula (1), the solution is as follows:

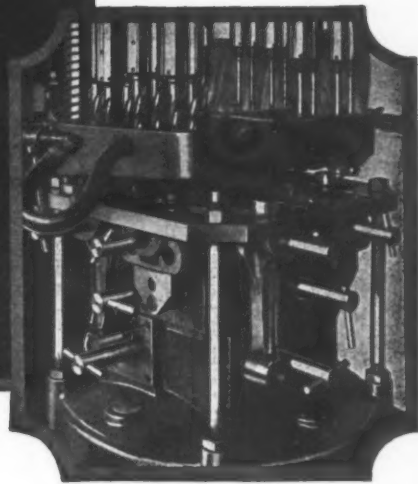
$$\begin{aligned} D &= \frac{(A - d)^2}{4d} = \frac{(3.297 - 0.460)^2}{4 \times 0.460} \\ &= \frac{2.837^2}{1.84} = \frac{8.049}{1.84} = 4.374 \text{ inches} \end{aligned}$$

**Example 2**—What is the diameter of a split liner if the measurement over pins of 1 inch diameter is 6.482 inches? Using Formula (2), the solution is as follows:

$$\begin{aligned} D &= \frac{(A - 1)^2}{4} = \frac{(6.482 - 1)^2}{4} \\ &= \frac{5.482^2}{4} = \frac{30.052}{4} = 7.513 \text{ inches} \end{aligned}$$



# Design of Tools and Fixtures



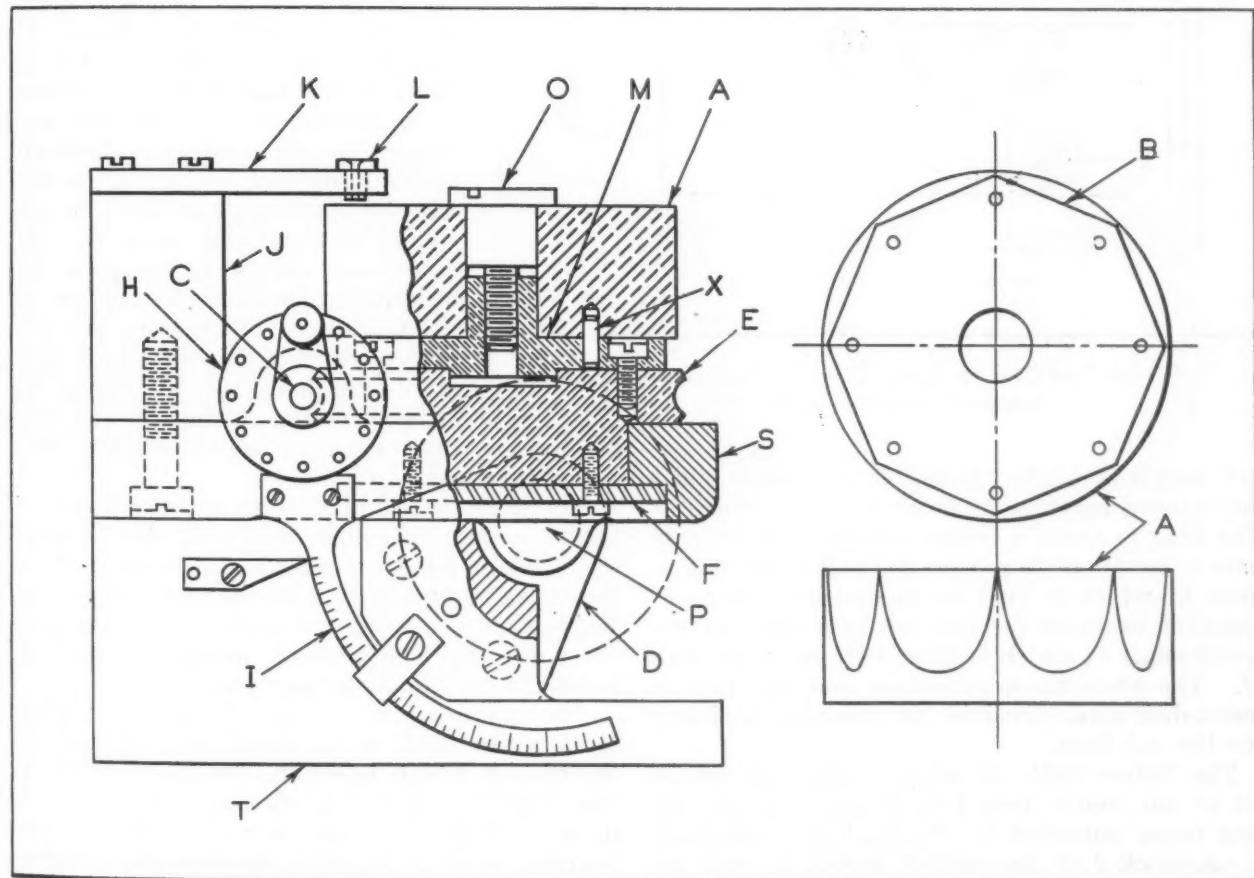
## Combination Jig for Drilling and Shaping Plastic Part

By JAMES H. RODGERS, Toronto, Ontario, Canada

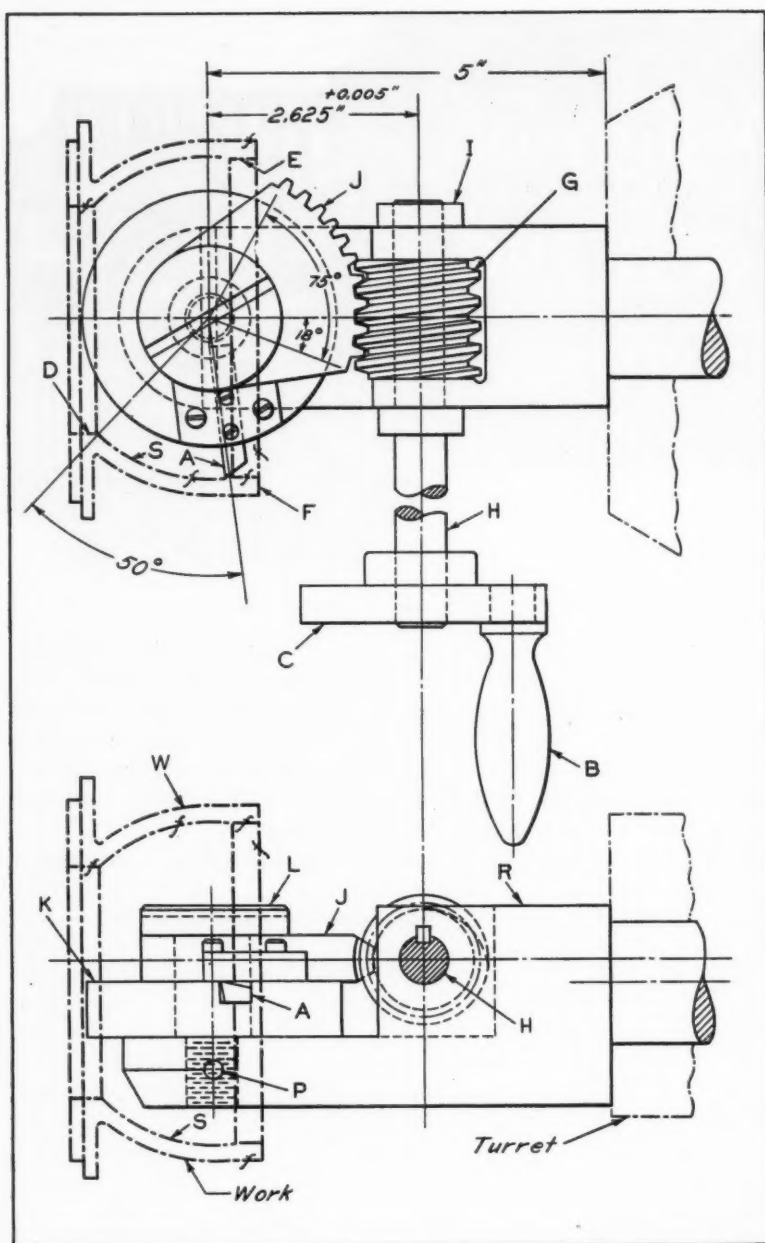
Having some pieces of plastic Catalin that were to be machined as shown at A in the accompanying illustration, a combination drill jig

and milling fixture was made for drilling the accurately spaced holes seen in the detail view of the piece, and for milling the eight surfaces B. The fixture was designed along universal lines to adapt it for handling similar parts requiring different spacing of the holes and for milling cuts at different angles.

The base T and the sub-base S of the fixture



Tilting and Indexing Fixture Arranged for Milling Surfaces B and Drilling Holes in Catalin Piece A .



Special Tool Used on Turret Lathe for Turning Internal Spherical Surface S of Part W

are cast-iron blocks, milled to the same width and hinged together at point P by the plates D. The base is about 4 inches square, and the sub-base is bored out to receive the hub of the worm-gear E, which is held by the retainer plate F. Integral brackets on the sub-base support the worm-shaft C, which is fitted with an index-disk H. The 60-tooth worm-wheel and the 12-hole index-disk make possible 720 indexing positions for the sub-base.

The fixture table or adapter plate M can be set at any angle from 1 to 90 degrees, the setting being indicated by the graduated quadrant I. A block J of the correct height to suit the work to be drilled is fitted to the sub-base. A plate K provided with a drill bushing L is se-

ances specified.

The body R of the tool is machined from a solid square cold-rolled steel bar, and is made of sufficient length to avoid interference of the hexagonal turret-slide with the cross-slide. The worm G is a commercial part, and is keyed to the shaft H. The collar I, pinned to shaft H, holds the unit in its proper place.

The worm-wheel sector J was remodeled from a standard worm-wheel and attached to the disk K which holds the cutting tool bit A. The shoulder-screw L holds sector J and disk K in a fixed position and serves as their pivot bearing. A pin P is passed through the threaded section of screw L to prevent the latter member from turning.

cured to the top surface of block J. Adapter plate M, fastened to the top of the worm-gear E, supports the work A.

In the case of the particular piece for which the fixture was designed, which is a Catalin disk 2 inches in diameter by 3/4 inch thick, a small pin X is used for locating purposes and a screw O for clamping the work to plate M. The machining of surfaces B to produce the octagonal shape was performed on a printer's metal-cutting saw, the table of which could be raised or lowered to any position within the range of the circular saw.

### Turret Tool for Turning Internal Spherical Surfaces

By EDWARD LAY, Chief Tool Designer  
Fairchild Camera & Instrument Corporation

The spherical contour turning tool here illustrated was designed to be used in one of the stations of a Warner & Swasey No. 3 turret lathe for machining the spherical cavity S in the piece W, as indicated by the dot-dash lines. The tool A is rotated by the handle B of handwheel C to finish-bore the spherical surface. The other turret stations are utilized for tools employed in boring the opening D in the base and sizing the straight bore E. The cross-slide turret is equipped for machining the outside surface of the work and for finishing the face F to the specified height. All operations are controlled by setting the lathe feed-stops to insure maintaining the dimensions within the toler-

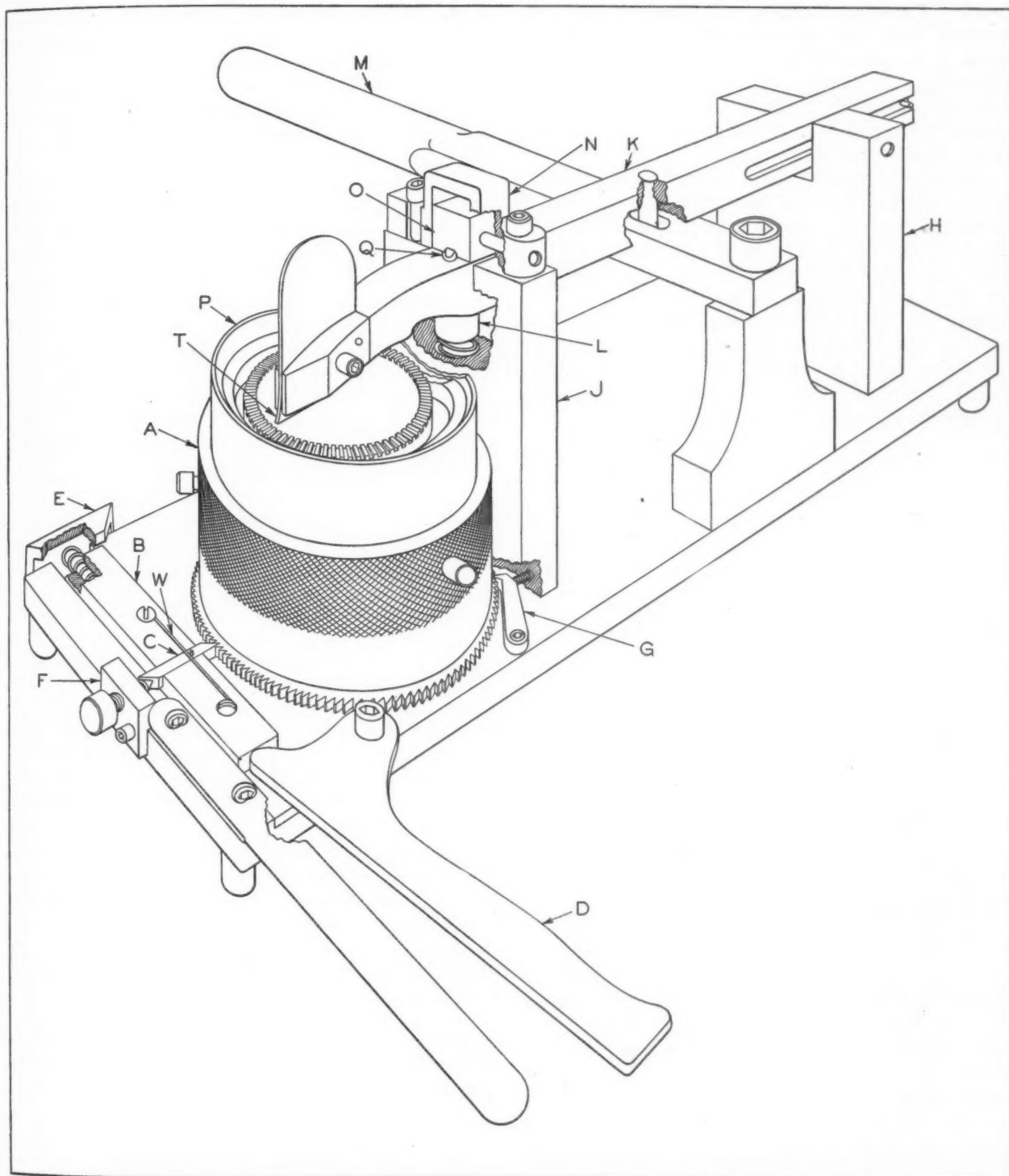
## Bench Fixture for Under-Cutting Mica Insulation

By G. F. GROSCHKE  
Schenectady Works, General Electric Co.

The bench fixture shown in the accompanying illustration was designed for the job of under-cutting the mica insulation between the copper

segments of a rheostat commutator to a depth of 0.015 inch. This special fixture was developed primarily because the shell *P*, which extends  $\frac{3}{8}$  inch above the face of the commutator, made it impractical to employ the conventional milling method of under-cutting.

The fixture consists of a rectangular baseplate on which is mounted a sleeve *A*, which can be rotated freely and which has a ratchet-gear



Lever-operated Fixture for Under-cutting Mica Insulation between Copper Segments of Commutator

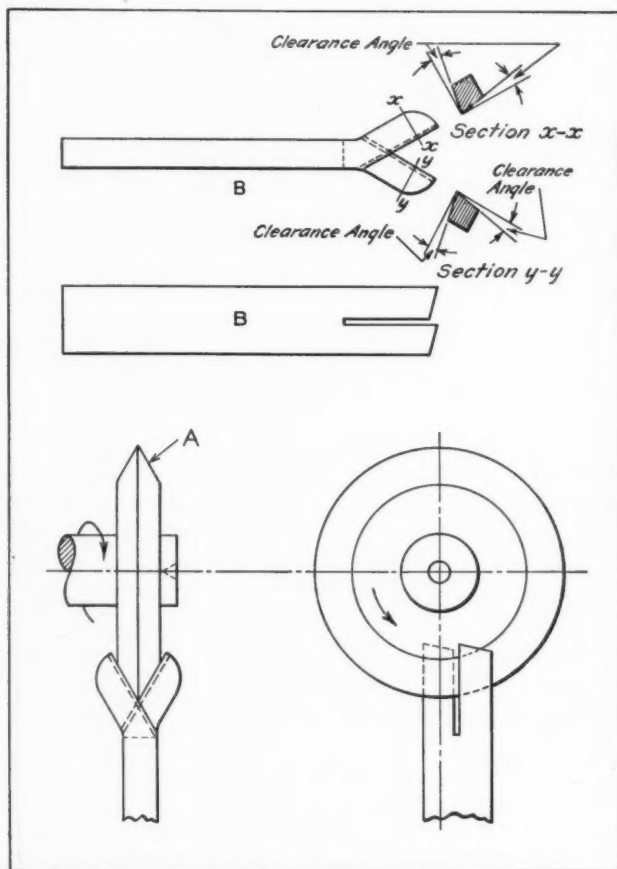
base. The number and spacing of the teeth in the ratchet gear correspond to those of the mica insulating strips to be under-cut. The upper half of the sleeve is knurled and is provided with three equally spaced set-screws which hold the shell securely in place when tightened.

A slot cut in the baseplate immediately in front of and tangent to the ratchet gear is fitted with a rectangular block *B*. This block is slotted to receive the sliding pawl *C*, which is held in place by a spring wire *W*, fastened to the sliding block. There is a pin in the pawl which is in contact with the spring wire *W*. The sliding block *B* is actuated by lever *D*, attached to the baseplate. A spring inserted in the left-hand end of the sliding block is backed up by an inverted L-shaped stop *E* which prevents block *B* from leaving the slot.

Directly in front of the pawl *C* and attached to the front end of the baseplate is a bracket *F* in which there is a screw that acts as an adjustment for the pawl. The pawl rotates the ratchet gear one notch with each feeding movement of the lever, but owing to the variation in the thickness of the mica and segments, it is necessary to provide the additional adjustment furnished by the screw in the bracket *F*. A stop *G* is attached to the baseplate at the side of the ratchet gear to prevent sleeve *A* from reversing.

To the rear of the sleeve and in line with it are two blocks *H* and *J*, which are fastened to the baseplate. Both blocks are slotted at the top and act as supports for the sliding arm *K*. In the rear block are two pins which ride in the guide grooves cut in two sides of the sliding arm. The front block has a spring cap *L* inserted in the bottom of its slot to permit vertical movement of the arm. A lever *M*, attached to another block, actuates the sliding arm, which has a thin cutting tool *T* of spring steel fastened to its head by means of a set-screw. This feature permits easy adjustment of the blade, as well as ready replacement.

On top of the front block and held by two set-screws is a small bracket *N* in which there is a slot containing a revolving square block *O*. As the lever pushes the sliding arm backward, pin *Q*, projecting from the upper surface of arm *K*, indexes the square block a quarter turn, which serves to lower the arm or cutter *T* 0.005 inch because of the off-center location of the surface of the block. The three faces of the square block *O* provide a total drop or down feed of 0.015 inch for the tool, while the fourth face returns the tool and its arm *K* to the normal starting position. Starting from this position each forward stroke cuts the mica down to a depth of 0.005 inch between the copper segments. The thickness of the blade used depends upon the thickness of the mica insulation.



Forming Tool B Used to Turn Periphery of Disk to Sharp Angle, as Shown at A

## Sharp-Angle Forming Tool

By MARTIN H. BALL, Watervliet, N. Y.

The tool *B* here illustrated has been used successfully for form-turning the edge of disk-shaped pieces, as indicated at *A*. This tool can be easily made by splitting the end of the bar material horizontally at its center for a sufficient depth to allow one part to be bent to the left and the other to the right to form the desired angular cutting edges. The bent ends of the tool are finished roughly to the required sizes and angles, hardened, and then ground with suitable side clearance and rake as required for the particular material to be machined.

This tool has the advantage of being easy to finish-grind, because the horizontal slot makes it possible to grind all cutting edges without requiring a wheel with a sharp corner. Reductions in machining time and a smoother finish due to elimination of chatter are additional advantages obtained with this tool.

\* \* \*

When the war is over, we shall have to learn the meaning of "costs" all over again.

# Pre-Reconversion Planning is of First Importance

**R**ECONVERSION to peacetime work, as everyone realizes, cannot be undertaken until the war contracts are completed and the war won. There are, however, many activities preceding actual reconversion of plants to peacetime production that can be undertaken now without interfering with the war effort in any way. This is pre-reconversion planning. By such advance planning, the unemployment gap between war production and peacetime production can be reduced to a minimum.

This pre-reconversion work includes engineering of peacetime products; design, building, and reconditioning of machine tools; and the making of tools, dies, and other auxiliary equipment. It also includes ordering the materials and parts necessary for the resumption of peacetime work, and making advance decisions as to the disposal of inventories and equipment not required for peacetime production.

Can this work be done without interfering with the war effort? Production executives say "yes." In the automotive field, where the plants have been more thoroughly converted to war work than in any other branch of industry, the duties of the product design engineers and of the die and tool designers have been completed so far as war production is concerned. They are now free to devote themselves to pre-reconversion planning without interfering with war production.

This is an important point to remember, because in all discussions of this subject, a clear distinction must be made between pre-reconversion planning and actual plant reconversion. Providing the workers in the war industries with a clear understanding of future plans, coupled with an adequate pre-reconversion program, is considered the best way to prevent war workers from leaving their jobs to obtain civilian employment as a means of escaping reconversion unemployment.

The Automotive Council for War Production has pointed out that the pre-reconversion activities undertaken up to this time will not solve the problem of prompt reconversion and re-employment. Other steps have to be taken. There must be an all-out Industry-Government teamwork. The manufacture of the machine tools necessary for partial reconversion must be urged in every case where there is no interference with machine tool production for war work.

Many machine tool builders are in a position to undertake the building of machine tools for peace work if restrictive Government regulations are modified. The tool and die industry also is in a position to undertake work for re-

conversion without interfering with war work. As a matter of fact, the working force of the tool and die industry is already being dispersed, a situation that may hinder the taking on of unexpected military work, as well as essential pre-reconversion work. For that reason, it is felt that pre-reconversion plans, and preparatory work which does not interfere with war production programs, should be free from wartime controls.

The importance of this lies chiefly in the fact that if this preliminary planning for a return to peacetime production has not been made in advance, it will require long periods of shut-down to change over from war work to peace work, and the period of unemployment will be unnecessarily prolonged.

It should be thoroughly appreciated that, in the main, pre-reconversion work requires men whose jobs are now largely completed as far as the military programs are concerned. The peak of preparations for production work on military programs was passed quite awhile ago. It now becomes a question of how the experience of these men can best be utilized. A few thousands of these men now employed on pre-reconversion work will reduce the period of unemployment of hundreds of thousands of workers.

As regards the release of materials for pre-reconversion work, the volume would be comparatively small and would not constitute a deduction from the materials necessary for the prosecution of the war.

The Government, as well as industry, has a serious stake in this matter. Despite the multiplicity of wartime rules and regulations and the number of pre-reconversion problems facing American industry, the Government has assumed the responsibility for the re-employment of millions of men and women by undertaking the impossible task of authorizing, individually, each one of the small but highly important pre-reconversion steps that must be taken.

The Automotive Council for War Production, therefore, urges the immediate establishment of a policy by the Director of War Mobilization and Reconversion that will permit individual manufacturers to freely undertake pre-reconversion activities which do not interfere with the war production program. These activities should have a place ahead of everything except the military programs of the United Nations. The policy should be applied to all converted industries, and should require all Government agencies to observe it. This can be done without jeopardizing the Government control over necessary military programs and over actual plant reconversion.



Fig. 1. Parabolic Antenna of Expanded Metal being Spun to Shape

## An Unusual Job of Metal Spinning

One of the most unusual and difficult metal-spinning operations ever performed at the plant of the Milwaukee Metal Spinning Co., Milwaukee, Wis., is that of shaping the parabolic antenna of expanded steel shown being spun in Fig. 1. The maple spinning block used in this operation is 8 feet 8 inches in diameter and weighs approximately 5000 pounds. The extremely large size of the work and the character of the metal being spun presented a challenge to the ingenuity of those performing this work.

Before spinning, two half circles of flattened expanded metal were welded together, making a circle 8 feet 6 inches in diameter. The spinning lathe was revolved at the rate of 185 R.P.M. while this circular disk was "dished" or "spun in" to the shape of the concave spinning block, which conformed to the parabolic shape.

After the expanded metal had assumed the necessary shape in the spinning lathe, it was removed and cut to the shape required for the finished antenna, as indicated in Fig. 2. Seamless tubing, 3/4 inch in diameter with a 1/8-inch wall thickness, was welded to the outer edge in order to strengthen the shaped expanded metal. All ragged edges were ground off. This product was formerly considered impossible to spin. The successful solution of the problem, therefore, is worthy of notice.

## Glass that Resists Action of Hydrofluoric Acid

A new glass that successfully withstands the corrosive action of hydrofluoric acid, which disintegrates ordinary glass, corrodes most metals, and produces dangerous burns, has been developed by the American Optical Co., Southbridge, Mass. This is the first glass known to offer resistance to the attack of hydrofluoric acid. The discovery will simplify the handling of this important acid, which is now extensively used in such industrial operations as the pickling of metals, etching of glass, and processing of textiles, as well as in oil refining and synthetic rubber manufacture.

In the past, hydrofluoric acid has had to be shipped in lead or wax containers, and in the laboratory has had to be handled in platinum or gold retorts, which prevented visual observance of chemical reactions.

To test the new glass, a piece of it was immersed in a bath of hydrofluoric acid for 500 hours. At the end of that time, the glass was still transparent, and showed no evidence of attack to the naked eye. An ordinary piece of glass immersed in this acid is converted in a few hours into a chalky mass. Even the tough and seemingly indestructible glass used in the manufacture of laboratory and kitchen ware is rapidly attacked.

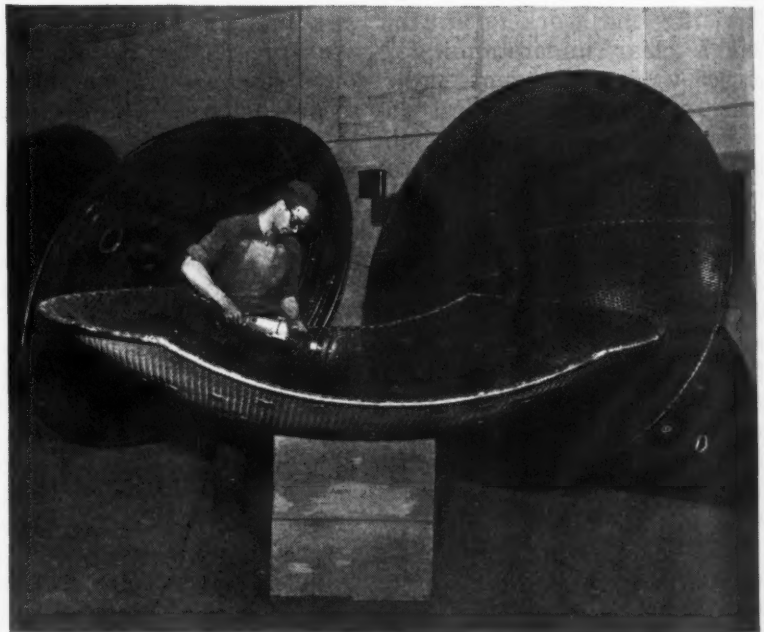


Fig. 2. Final Step in Finishing the Completed Antenna

# Computing Angular Dimensions for a Cam Milling Operation

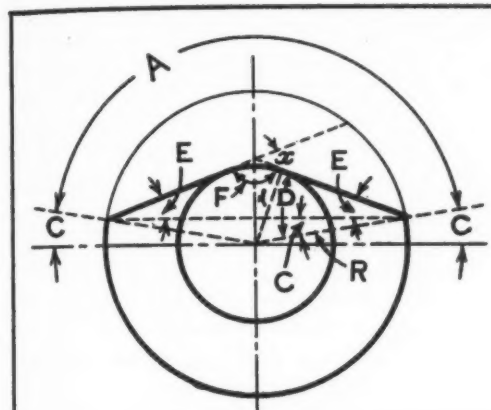
By J. HOMEWOOD

From time to time the shop man may be given drawings that do not furnish all the information needed for machining. Some essential dimensions may be omitted because, perhaps, of the draftsman's lack of definite information about certain phases of shop practice.

A case in point, taken from actual practice, was where the angular dimension given on a drawing was not the one required for machin-

ing. The accompanying diagrams show a shaft with a round piece attached to one end which is to be cut away to form a cam. Angle A, which is the angle between the radial lines that intercept the ends of the cutaway section, was specified on the drawing. Since the job was to be done on a milling machine, angle x was required to permit the correct indexing of the work-piece.

The actual problem is illustrated by Case 1. There are two variations of this problem illustrated by Case 2, where angle A equals 180 degrees, and Case 3, where angle A is greater than 180 degrees.



CASE 1. Angle A is less than 180 degrees.

Derivation:

$$\begin{aligned} x &= 180^\circ - F \\ 2E &= 180^\circ - F \\ \text{therefore } x &= 2E \\ E &= D - C \end{aligned}$$

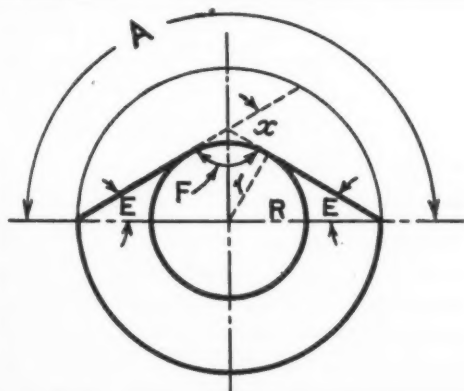
$$\text{Sine } D = \frac{r}{R}$$

$$C = \frac{180^\circ - A}{2}$$

$$x = 2 \left( D - \frac{180^\circ - A}{2} \right)$$

Example:

$$\begin{aligned} A &= 140^\circ \\ r &= 1 \\ R &= 2 \\ \text{sine } D &= \frac{r}{R} = \frac{1}{2} = 0.5 \\ D &= 30^\circ \\ x &= 2 \left( D - \frac{180^\circ - A}{2} \right) \\ x &= 2 \left( 30^\circ - \frac{180^\circ - 140^\circ}{2} \right) \\ x &= 2 (30^\circ - 20^\circ) = 20^\circ \end{aligned}$$



CASE 2. Angle A is equal to 180 degrees.

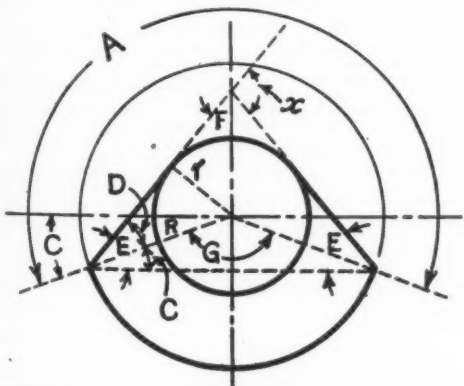
Derivation:

$$\begin{aligned} x &= 180^\circ - F \\ 2E &= 180^\circ - F \\ \text{therefore } x &= 2E \end{aligned}$$

$$\text{Sine } E = \frac{r}{R}$$

Example:

$$\begin{aligned} A &= 180^\circ \\ r &= 1 \\ R &= 2 \\ \text{sine } E &= \frac{r}{R} = \frac{1}{2} = 0.5 \\ E &= 30^\circ \\ x &= 60^\circ \end{aligned}$$



CASE 3. Angle A is greater than 180 degrees.

Derivation:

$$\begin{aligned} x &= 180^\circ - F \\ 2E &= 180^\circ - F \\ \text{therefore } x &= 2E \\ E &= D + C \\ \text{therefore } x &= 2 (D + C) \end{aligned}$$

$$\text{sine } D = \frac{r}{R}$$

$$2C = A - 180^\circ$$

$$C = \frac{A - 180^\circ}{2}$$

$$x = 2 \left( D + \frac{A - 180^\circ}{2} \right)$$

Example:

$$\begin{aligned} A &= 220^\circ \\ r &= 1 \\ R &= 2 \\ x &= 2 \left( D + \frac{A - 180^\circ}{2} \right) \\ \text{sine } D &= \frac{r}{R} = \frac{1}{2} = 0.5 \\ D &= 30^\circ \\ x &= 2 \left( 30^\circ + \frac{220^\circ - 180^\circ}{2} \right) \\ &= 2 (30^\circ + 20^\circ) \\ x &= 100^\circ \end{aligned}$$

Formulas for Computing Angular Dimensions for a Cam Milling Operation when Angle A is Less than 180 Degrees; Equal to 180 Degrees; and Greater than 180 Degrees

# Materials of Industry

## THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

### Sealing Compound for Spot-Welded Joints

A new sealing compound for spot-welded joints has been developed by the Presstite Engineering Co., St. Louis, Mo. This compound, called Presstico spot-weld sealer, is produced in three types for flow gun, brush, or spray application. All three types have high resistance to dilute acids, alkalies and mineral oils. They have no corrosive effect on metals.

Tests were made on a small box in which the seams were spot-welded at a 3-inch pitch. Presstico sealer was used in all joints, and the box was filled with water. After two weeks of testing, no leak was observed in the box. Tests on sample lap joints showed tensile strengths up to 2600 pounds per square inch. Panels in which the Presstico sealed joint was used were run through a paint system without bonderizing and with bonderizing, including a three-minute dip at 210 degrees F. in a 2.5 per cent caustic potash solution. No deleterious effect was observed on the material in the seam. Spot-weld panels left in a salt spray for two weeks and others kept in an atmosphere of 100 per cent relative humidity at 100 degrees F. for one week showed good protection at the seam. ....201

### Hot-Melt Dip Package for Metal Parts

"Stripcoat," a hot-melt dip type of package, has been developed by the Dow Chemical Co., Midland, Mich., to protect and package metal parts in one operation. Metal parts that are dipped in molten "Stripcoat" are coated with a tough, skin-tight protective layer, which conforms to the identical contours of the part and remains tough and durable throughout a wide range of temperatures. The molten material sets quickly without the aid of mechanical drying equipment, and can easily be removed by slitting and stripping from the part. Application of the coating is easily adapted to production-line procedure, and manufacturers now using it report savings of from 60 to 90 per cent in packaging time, compared with conventional pre-war methods. .... 202

### Two Chromium Inoculants for Cast Iron

Two stabilizing inoculants for cast iron which provide all the well-known advantages of chromium without the usual increase in depth of chill have been developed by Electro Metallurgical Co., a Unit of Union Carbide and Carbon Corporation, New York City. These new ladle-addition alloys, known as CMSZ 4 and 5, are a handy means of adding both chromium and strong graphitizing agents for improving the physical properties of a cast iron.

Chief among the advantages derived are the increased hardness and wear resistance obtained from the addition of chromium, which are achieved with little or no loss in machinability. The new alloys also improve the tensile and transverse strength of a cast iron and greatly reduce the tendency to grow. They impart higher resistance to oxidation and to the annealing effect of elevated temperatures...203

### Heat-Resistant "Lucite" with Improved Properties

A new molding compound of "Lucite" methyl methacrylate resin combining a heat resistance 30 to 40 degrees F. higher than general-purpose powders and other desirable properties previously unobtainable in a single formulation, has been announced by the Plastics Department of E. I. du Pont de Nemours & Co., Arlington, N. J.

The new compound, designated HM-122, is outstanding for ease and economy in molding. Its faster setting properties, when properly heated dies are used, contribute to a shorter molding cycle, and its added resistance to breakdown from heat at molding temperatures produces not only better moldings but improved clarity.

Moldings of the new "Lucite" not only have unusual clarity and brilliance, but also possess excellent reflecting properties and are exceptionally free from distortion when molded properly. The new compound can be obtained in a wide range of transparent, translucent and opaque colors for both indoor and outdoor use.

The entire output of HM-122 now is allocated to essential uses, such as colored caps for switch-board light signals, parts for sextants and stethoscopes, blackout lenses for military vehicles, airfield landing light lenses, relay box covers, battery adapters, and control-wheel knobs.

Post-war commercial and industrial applications are expected to include tail-light and other colored lenses, covers for running lights of planes and ships, and products in which transparent protective covering operate under high temperatures. . . . . 204

## "CarboRustex," A Newly Developed Rust Solvent

A new solvent for rust known as "CarboRustex" is being manufactured by the Carbozite Corporation, First National Bank Bldg., Pittsburgh 22, Pa. This solvent has an affinity for rust itself, but will not attack the unoxidized metal. It is applied by brushing, spraying, or dipping, spreads readily, and leaves no globules. The solvent is non-inflammable, and is not toxic nor injurious to the skin.

Surfaces treated with "CarboRustex" remain chemically clean and quite vulnerable to oxidation. A sufficient quantity of a chemical rust inhibitor is also provided for rinsing off the metal surface after the rust has been removed. This rust inhibitor will protect the surface from oxidation for several days, or until the surface can be permanently protected with a protective coating. . . . . 205

*Transparent Plastic Tubing Containing Mercury is Shown Here being Used for the Observation and Recording by Motion Pictures of the Behavior of Aircraft Instruments during Test Flights. The Tubing is Made of Compar, a Special Type of Vinyl Resin Developed by Resistoflex Corporation of Belleville, N. J. The Tubing is Tough, Strong, and Completely Impervious to Almost All Organic Solvents*

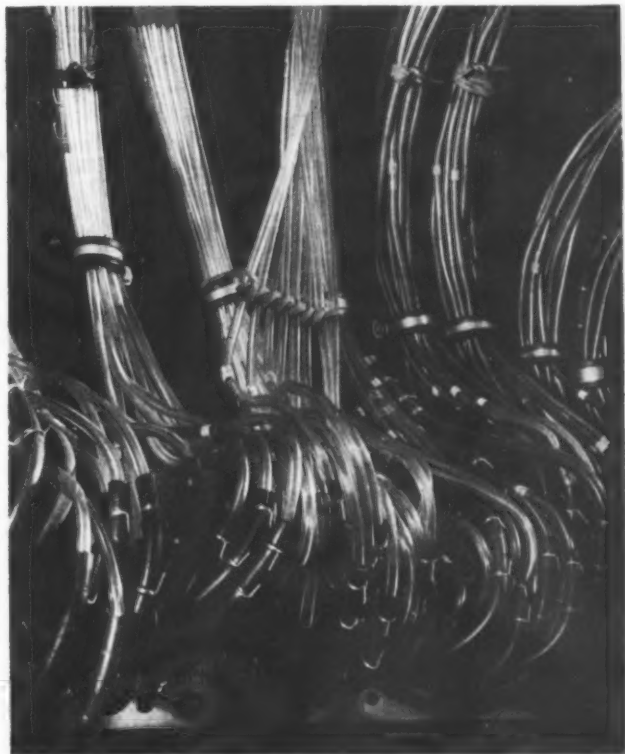
## Ferrous Blackening Process Provides Tough, Durable Finish

A new and simpler chemical blackening process for ferrous parts, called "Ferrotoning," has been developed by Turco Products, Inc., 6135 S. Central Ave., Los Angeles 1, Calif. This process utilizes simple immersion equipment, and is carried on at a temperature considerably below that required by oxide finishing. It is stated that, with the new process, it is not necessary to maintain two oxidizing solutions, as required in most processes.

"Ferrotoning" provides a bright or matte black finish integral with the metal and extremely durable. This finish does not chip, flake, or peel off even under repeated flexing, and cannot be removed under routine cleaning operations by the action of solvents or degreasing agents. . 206

## Colored Finishes for Zinc and Cadmium Surfaces

"Iridite," an anti-corrosive final finish for zinc and cadmium surfaces, produced by Rheem Research Products, Inc., 2523 Pennsylvania Ave., Baltimore 17, Md., is now being made available in a wide selection of standard colors, including bronze, black, blue-black, blues, greens, and maroons. The new Iridite bronze color is, like the original Iridite olive drab, a basic one-dip coating. The other colors require two dips, one for the basic coat and one for the dye. All colors are uniform and do not fade. . . . . 207



To obtain additional information about materials described on this page, see lower part of page 200.

## Metal-Cutting Saw—An Example of Welded-Frame Design

Probably no other field of construction has seen such rapid strides in the development and use of arc welding as that of machine design. The metal-cutting power saw built by the Loma Machine Mfg. Co., Inc., New York City, shown in Fig. 2, is an example of the progress made in this type of welded construction. In designing this machine, the aim was to construct the housing heavy enough to make the machine suitable for cutting large billets. This housing, Fig. 1, exemplifies the simplicity of the design possible with welded construction. The material used was mild steel plate varying in thickness up to 5/8 inch and cut to sizes ranging up to 100 inches square. The welding was performed with Lincoln electric equipment.

The pieces were rough-ground at the edges, fitted together, and arc-welded after mounting on a 5-ton positioner, making it possible to do most of the welding "downhand." Large sizes of electrodes were used wherever possible to assure high-speed deposition of weld metal. Butt and fillet welds predominated in the fabrication, with both outside and inside welding at the joints. The excess weld metal was removed by grinding the outside joints to a smooth contour.

With the exception of several minor parts, which are bolted to the frame for convenience in assembly and disassembly, the entire frame is arc-welded. The weight of the welded frames or housings ranges from 1500 to 8900 pounds.

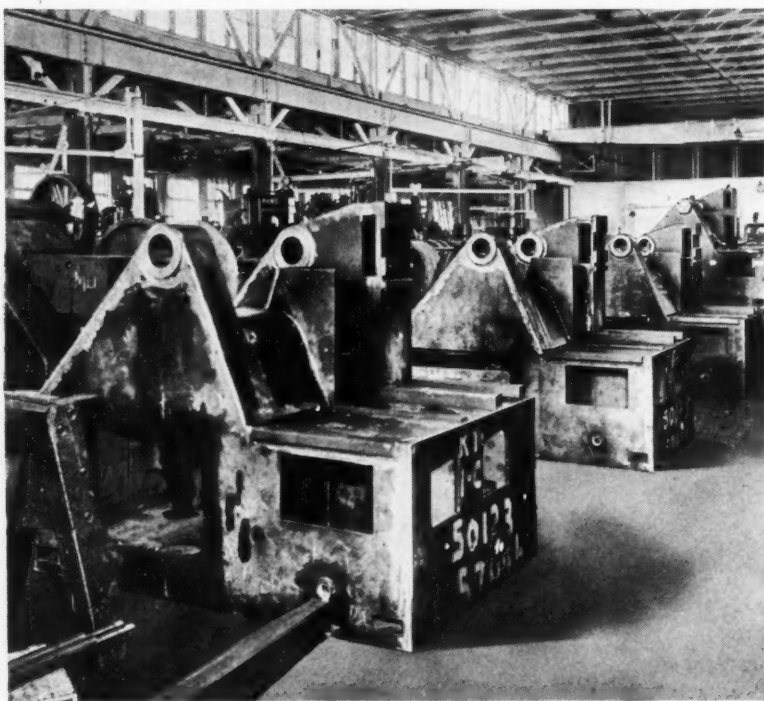


Fig. 1. Welded Housings for Metal-cutting Saws

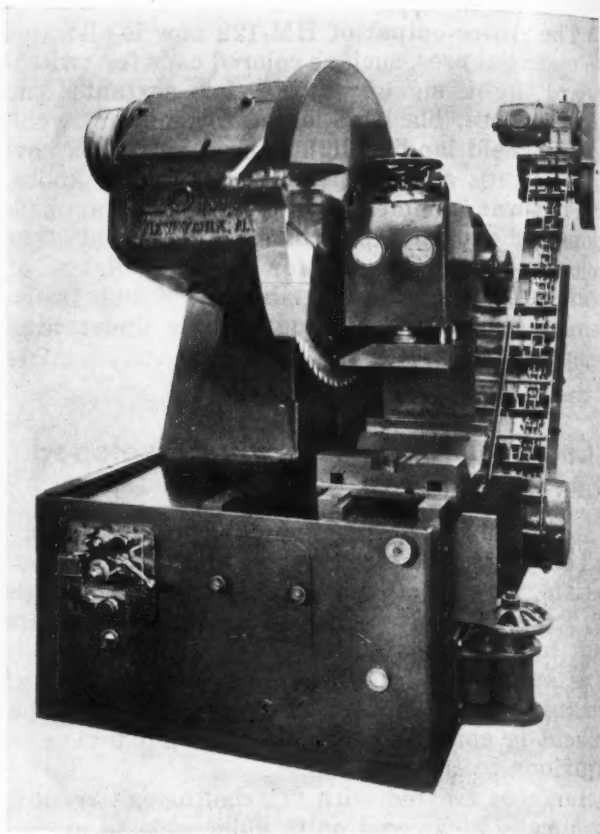


Fig. 2. Metal-cutting Saw in which the Housing, Guards, etc., are of Arc-welded Design

This saw has a unique motor-driven conveyor arrangement whereby the metal chips are deposited in a chip receptacle. The welded guard and housing for the chain drive are shown to the right in Fig. 2. The chips are carried from the base by a conveyor screw which is also of welded design.

\* \* \*

### Automotive Engineers Will Hold Annual Meeting in Detroit

The Society of Automotive Engineers will hold its annual meeting at the Book-Cadillac Hotel, Detroit, Mich., January 8 to 12. This meeting, which has been designated the "War Engineering" meeting, will cover a great variety of subjects pertaining to the automotive and aircraft fields. Upward of thirty different sessions have been planned on aircraft and air transportation, passenger cars, trucks and buses, fuels and lubricants, Diesel engines, materials, production, and maintenance.

# New Trade Literature

## RECENT PUBLICATIONS ON MACHINE SHOP EQUIPMENT, UNIT PARTS, AND MATERIALS

To Obtain Copies, Fill in on Form at Bottom of Page 199 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the January Number of MACHINERY

### "Heli-Coil" Salvage Service

AIRCRAFT SCREW PRODUCTS CO., INC., 47-23 Thirty-Fifth St., Long Island City 1, N. Y. Bulletin 240, describing "Heli-Coil" insert kits for field servicing, salvage, and maintenance of stud and cap-screw assemblies. Bulletin 260, describing two maintenance and salvage operations that resulted in great savings in the shops of an airline and an aircraft-engine manufacturer. ....1

### "Hardsteel" Drill Operator's Manual

BLACK DRILL CO., DIVISION OF BLACK INDUSTRIES, 1400 E. 222nd St., Cleveland 17, Ohio. "Hard-steel Drill Operator's Manual," containing tables of drilling speeds for hardened steels, instructions for wet and dry drilling, and new information on the application of "Hardsteel" tool bits in the machining of steel, copper, and aluminum alloys. ....2

### Nickel Alloys

INTERNATIONAL NICKEL CO., INC., 67 Wall St., New York 5, N. Y. Publication entitled "Corrosion," containing a comprehensive analysis of corrosion processes and factors influencing their action. Data is given on the characteristics of Monel, nickel, and Inconel and their applicability in various corrosive media. ....3

### Cast Steels and Steel Castings

LEBANON STEEL FOUNDRY, Lebanon, Pa. Chart on carbon and low alloy structural cast steels, listing physical properties and comparable designations of U. S. Navy, Federal, A.S.T.M., A.I.S.I., SAE and

NE steels. Also chart on corrosion- and heat-resistant alloy steels, giving similar data. ....4

### Electric Temperature Control Equipment

LEEDS & NORTHRUP CO., 4934 Stenton Ave., Philadelphia 44, Pa. Catalogue N-OOA(2), describing in detail a new Micromax electric temperature control system of the duration-adjusting type for heat-treating furnaces, ovens, baths, or other units. ....5

### Milling Machine Tools and Accessories

KEARNEY & TRECKER PRODUCTS CORPORATION, Milwaukee, Wis. Catalogue C10 (50 pages), giving complete listings and information on arbors, cutters, vises, high-speed attachments, and center scope for every standard milling machine. ....6

### Abrasive Cutting

ANDREW C. CAMPBELL DIVISION, AMERICAN CHAIN & CABLE CO., INC., Bridgeport, Conn. Campbell Abrasive Cutting Tip Sheet, containing questions and answers on specific cutting problems. Circular describing the Campbell completely automatic abrasive cutting machine. ....7

### Flexible-Shaft Handbook

S. S. WHITE DENTAL MFG. CO., Industrial Division, 10 E. 40th St., New York 16, N. Y. Handbook containing 256 pages of engineering data on flexible shafts and their application. Available only to those making requests on a business letterhead and indicating title or position. ....8

### Cold-Sawing Manual

MOTCH & MERRYWEATHER MACHINERY CO., Penton Bldg., Cleveland 13, Ohio. Circular containing production data on sawing various materials by the Motch & Merryweather "Triple-Chip" method, together with descriptions of the process and the machines used. ....9

### High-Speed Production Tools

ZAGAR TOOL, INC., 23880 Lakeland Blvd., Cleveland 17, Ohio. Loose-leaf catalogue covering the line of high-speed production tools made by this concern, including collet indexing fixtures, air-operated fixtures, speed chucks, broaching machines, etc. ....10

### Electric Control Equipment

MICRO SWITCH DIVISION, Freeport, Ill. Handbook-Catalogue 71, containing 100 pages of data on heavy-duty type Micro switches and auxiliary devices for electrical controls in the aircraft, automotive, marine, railway, and heavy machinery fields. ....11

### Meehanite Castings

MEEHANITE RESEARCH INSTITUTE OF AMERICA, INC., Pershing Square Bldg., New Rochelle, N. Y. Bulletin 21, illustrating typical applications of special heat-resisting Meehanite castings and containing data on properties. ....12

### V-Belt Drives

MULTIPLE V-BELT DRIVE ASSOCIATION, 140 S. Dearborn St., Chicago 3, Ill. Booklet entitled "19 Reasons Why it is the Dominant Drive of Industry," describing the basic advantages of multiple V-belt drives. ....13

### Multiple-Spindle Drill Heads

THRIFTMASTER PRODUCTS DIVISION OF ZIMMER-THOMSON CORPORATION, 29-05 Review Ave., Long Island City 1, N. Y. Pamphlet illustrating and describing the Thriftmaster multiple-spindle drill heads. \_\_\_\_\_14

### Oxy-Acetylene Pipe-Line Installations

AIR REDUCTION, 60 E. 42nd St., New York 17, N. Y. Booklet entitled "Oxy-Acetylene Pipe-Line Installations," describing typical plans for various sized industrial plants. \_\_\_\_\_15

### Hydraulic Units

JOHN S. BARNES CORPORATION, 301 S. Water St., Rockford, Ill. Bulletin 301-U, illustrating and describing the Barnes line of hydraulic units for application to machine tools and other machinery. \_\_\_\_\_16

### Hot-Work Tool Steels

CRUCIBLE STEEL CO. OF AMERICA, 405 Lexington Ave., New York 17, N. Y. Tool Steel Bulletin No. 6, giving complete information on the application and heat-treatment of the hot-work steels made by this company. \_\_\_\_\_17

### Tube-Machining Equipment

LEONARD PRECISION PRODUCTS CO., 1100 Larson Ave., Garden Grove, Calif. Circular announcing the new improved Leonard 3-CP "Tube Master" for squaring, flaring, burring, and beading ferrous and non-ferrous tubing. \_\_\_\_\_18

### Aluminum and Zinc Castings

MONARCH ALUMINUM MFG. CO., Cleveland 2, Ohio. Catalogue illustrating aluminum die-castings, permanent-mold castings, and sand castings, as well as zinc die-castings. Complete specifications are included. \_\_\_\_\_19

### Resistance Welding Data

RESISTANCE WELDER MANUFACTURERS' ASSOCIATION, 505 Arch St., Philadelphia 6, Pa. Booklet giving standard nomenclature, definitions, and other data covering resistance welding equipment. \_\_\_\_\_20

### Heat-Treating Baths

A. F. HOLDEN Co., New Haven 8, Conn. Bulletin 120, containing in-

formation on Holden neutral baths used for hardening and tempering, as well as data on Holden "flow" heat-treatment and the new speed nitriding process. \_\_\_\_\_21

### Automatic Thread Millers

UNIVERSAL ENGINEERING CORPORATION, Cedar Rapids, Iowa. Bulletin 1044, illustrating and describing the new Universal U-6 automatic thread miller for precision internal and external production threading. \_\_\_\_\_22

### High-Speed Electric Hand Tool

PRECISE PRODUCTS Co., 1328 Clark St., Racine 3, Wis. Bulletin descriptive of an electric hand tool designed to operate at 35,000 R.P.M., and weighing only 35 ounces. \_\_\_\_\_23

### Glass Electrical Insulation Materials

OWENS-CORNING FIBERGLAS CORPORATION, Toledo 1, Ohio. Catalogue EL 44-7, giving data on the properties, forms, and applications of Fiberglas electrical insulation materials. \_\_\_\_\_24

### Screw Thread Fits

GREENFIELD TAP & DIE CORPORATION, Greenfield, Mass. Booklet comprising a guide to screw thread fits, containing tap and product limits and tolerances for various classes of fits. \_\_\_\_\_25

### Die and Mold Duplicators

GEORGE GORTON MACHINE CO., 1312 Racine St., Racine, Wis. Bulletin 1319-E, descriptive of three models of Gorton die and mold duplicators, which are also applicable to production profiling work. \_\_\_\_\_26

### Broach Sharpeners

COLONIAL BROACH CO., P.O. Box 37, Harper Station, Detroit 13, Mich. Bulletin CS2-44, describing this company's new broach sharpening machine for flat and round broaches. \_\_\_\_\_27

### Aircraft Tool Manual

AIRCRAFT TOOLS, INC., 750 E. Gage Ave., Los Angeles 1, Calif. 178-page reference manual containing full construction details of small hand tools for aircraft production and maintenance. \_\_\_\_\_28

### Speed Control Equipment

REEVES PULLEY Co., Columbus, Ind. Folder entitled "Speed Control Quiz," containing nine questions and answers that give a quick summary of what can be accomplished by the use of the Reeves speed control. \_\_\_\_\_29

### Hot Dip Tanks

AEROIL BURNER CO., INC., Box BG, West New York, N. J. Catalogues on electrically heated hot dip tanks, gas-fired hot dip tanks and hot dip tanks that are designed to use either gas fuel or electric heat. \_\_\_\_\_30

### Gear-Finishing Machines

MICHIGAN TOOL CO., 7171 E. McNichols Road, Detroit 12, Mich. Technical bulletin 860-B-44, describing the improved Model 860-B line of crossed-axis gear-finishing machines. \_\_\_\_\_31

### Carboloy Mandrels for Tube Mills

CARBOLOY COMPANY, INC., 11147 E. Eight Mile Blvd., Detroit 32, Mich. Booklet entitled "Tips for Tube Mills and Use of Carboloy Mandrels." \_\_\_\_\_32

### Corrosion-Resisting Alloy

BRIDGEPORT BRASS Co., Bridgeport 2, Conn. Manual containing 80 pages of specifications and technical data on five high-strength, corrosion-resisting copper-base alloys known as "DuRonz." \_\_\_\_\_33

### High-Pressure Die-Casting Machines

LESTER-PHOENIX, INC., 2711 Church Ave., Cleveland 13, Ohio. Folder illustrating and describing the Lester-Phoenix line of high-pressure die-casting machines. \_\_\_\_\_34

### Production Chart Calculator

DESIGNERS FOR INDUSTRY, INC., 2915 Detroit Ave., Cleveland 13, Ohio. Chart for scheduling work, taking into account six basic steps of development of new products to be ready at a given time. \_\_\_\_\_35

### Small Tools

LAKE SHORE TOOL WORKS, INC., 816 N. Kostner Ave., Chicago 51, Ill. Catalogue containing 116 pages covering the line of high-speed steel and carbide tools made by this company. \_\_\_\_\_36

## Electric Controls

GENERAL ELECTRIC Co., Schenectady 5, N. Y. Circular GEA-4214, descriptive of a new electronic relay which provides floatless control of the levels of many liquids. ....37

## Pneumatic Saws

CLEVELAND PNEUMATIC TOOL Co., 3781 E. 77th St., Cleveland 5, Ohio. Bulletin 95S, on the new Cleco pneumatic "baby" saw for cutting steel, brass, aluminum, etc. ....38

## Flame-Cutting Equipment

CENTRAL BOILER & MFG. Co., 5818 Rivard St., Detroit 11, Mich. Folder pointing out the advantages of flame cutting on certain manufacturing operations. ....39

## Dividing Heads

NICHOLS - MORRIS CORPORATION, 50 Church St., New York 7, N. Y. Bulletin illustrating and describing the new Ellis double-swivel precision dividing head. ....40

## Leather Belting Manual

GRATON & KNIGHT Co., 356 Franklin St., Worcester 4, Mass. 56-page manual containing data on the selection and application of leather belting. ....41

## Industrial Timers

PARAGON ELECTRIC Co., 37 W. Van Buren St., Chicago 5, Ill. Bulletin 4492, describing a new automatic electric industrial timer. ....42

## Miniature Ball Bearings

MINIATURE PRECISION BEARINGS, Keene, N. H. Bulletin 44, describing various applications of miniature radial and pivot type precision ball bearings. ....43

## Steel Stamps

ACROMARK Co., 9-11 Morrell St., Elizabeth, N. J. Folder containing data and prices on heavy-duty steel letter and figure stamps for industrial use. ....44

## Cranes

SILENT HOIST & CRANE Co., Brooklyn 20, N. Y. Catalogue 58, containing concise specifications on the Krane Kar mobile swing boom crane. ....45

## Air-Operated Devices

AIROP INCORPORATED, 12841 Ford Road, Dearborn, Mich. Folder illustrating typical applications of air-operated devices made by this company. ....46

## Lubricants

ACHESON COLLOIDS CORPORATION, Port Huron, Mich. Folder 440, describing a number of new colloidal graphite dispersions in various fluids. ....47

## Welding Electrodes

P. R. MALLORY & Co., INC., Indianapolis 6, Ind. Catalogue on electrodes and alloys for resistance welding. ....48

## Hydraulic Straightening Presses

COLONIAL BROACH Co., P. O. Box 37, Harper Station, Detroit 13, Mich. Bulletin VL1-44, illustrating and describing hydraulic straightening presses. ....49

## Automatic Bending Machines

PINES ENGINEERING Co., INC., 600 Prairie, Aurora, Ill. Catalogue illustrating and describing Pines automatic benders with finger-tip push-button control. ....50

## Materials-Handling Equipment

LEWIS-SHEPARD PRODUCTS INC., 288 Walnut St., Watertown 72, Mass. Circular 80-109, entitled "Time-Tested Materials-Handling Equipment." ....51

## Salt Baths

AJAX ELECTRIC Co., INC., Frankford Ave. at Delaware Ave., Philadelphia 23, Pa. Booklet descriptive of salt bath quenching processes. ....52

## Dies for Aircraft Parts

MASONITE CORPORATION, 111 W. Washington St., Chicago, Ill. Bulletin entitled "Low-Cost Dies for Aircraft Parts." ....53

## Die-Casting Machines

KUX MACHINE Co., 3924 W. Harrison St., Chicago 24, Ill. Catalogue dealing comprehensively with die-casting machines. ....54

## To Obtain Copies of New Trade Literature

listed on pages 197-200 (without charge or obligation), fill in below the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail within three months of the date of this issue to:

**MACHINERY, 148 Lafayette St., New York 13, N. Y.**

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Name.....Position or Title.....

[This service is for those in charge of shop and engineering work in manufacturing plants.]

Firm.....

Business Address.....

City.....State.....

[SEE OTHER SIDE]

MACHINERY, January, 1945—199

### Fastening Devices

SHAKEPROOF, INC., 2501 North Keeler Ave., Chicago, Ill. Circular illustrating typical applications of Shakeproof lock-washers. ....55

### Brazing Carbide Tool Tips

HANDY & HARMAN, 82 Fulton St., New York 7, N. Y. Bulletin 11-A, entitled "Brazing Carbide Tool Tips with Easy-Flo No. 3."...56

### Fabricated Tubular Parts

WOLVERINE TUBE DIVISION, CALUMET & HECLA CONSOLIDATED COPPER Co., Detroit 9, Mich. Catalogue on fabricated tube parts. ....57

### Laboratory Utilities

PRECISION SCIENTIFIC Co., 1750 N. Springfield Ave., Chicago, Ill. Catalogue 600, on laboratory utilities and equipment. ....58

### Hydraulic Pumps

LYON - RAYMOND CORPORATION, 1943 Madison St., Greene, N. Y. Bulletin 138, on foot- and hand-operated hydraulic pumps. ....59

### Chain Hoists and Trolleys

CHESTER MFG. Co., Lisbon, Ohio. Bulletin entitled "The Chain Hoist of Tomorrow, Today, and Yesterday." .....60

### Cellulose Plastics

HERCULES POWDER Co., Wilmington, Del. Folder illustrating the properties of cellulose plastics.....61

### New Flame-Resistant Gaskets Replace Rubber

A new type of gasket consisting of a felt base impregnated with a chromate pigmented compound which renders the material flame- and fire-resistant, as well as corrosion-resistant, has been placed on the market by the Sherwin-Williams Co., 1182 Broadway, New York City.

Originally, this new material was developed for use as a substitute for low-pressure rubber gaskets in marine ventilating systems. Later, however, these gaskets demonstrated their usefulness in many other applications, including joint seals in water, fuel oil, and Diesel-engine oil systems, as well as for airlock gaskets and refrigerator door gaskets.

\* \* \*

### Increasing the Life of Tools by the Use of the Right Cutting Fluid

The use of the right kind of cutting fluid has as much effect on production as machines and tools. In one extreme instance, it is reported that a manufacturer of tanks, in milling threads on parts made from S A E 3250 steel, heat-treated to 48-50 Rockwell C, increased the life of the cutting tool sevenfold by following the recommendations of the service engineer of an oil company.

### Twisted Twist Drills Used Extensively by Ford

Many tons of high-speed steel have been saved during the war emergency in the Ford plants by the widespread use of twisted drills. A practicable method for making twisted drills was developed at the Rouge plant of the Ford Motor Co. These drills are made in sizes from 3/16 to 29/32 inch. The claims made for drills of this construction are low cost and greater strength than that of conventional drills.

These twisted drills are made from rolled forged stock of predetermined dimensions, which is then hot-twisted to the desired spiral. The spiral thus is produced by roll-forging and twisting instead of by milling, as in conventional twist drill manufacture.

\* \* \*

### Engineering Society of Buffalo Celebrates Fiftieth Anniversary

The Engineering Society of Buffalo, Buffalo, N. Y., has just completed fifty years of service to the engineering profession. This Society was originally organized November 27, 1894, under the name of the Engineering Society of Western New York. In 1912, the name was changed to the Engineering Society of Buffalo.

## To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 208-232 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equip-

ment, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning machine as described in January, 1945, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Fill in your name and address on other side of this blank.

## To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 194-195, fill in below the identifying number found at the

end of each description—or write directly to the manufacturer, mentioning name of material as described in January, 1945, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.
-----	-----	-----	-----	-----	-----	-----	-----	-----

Fill in your name and address on other side of this blank.

Detach and mail to MACHINERY, 148 Lafayette St., New York 13, N. Y.

[SEE OTHER SIDE]


sed  
d  
steel  
e war  
nts by  
wisted  
d for  
devel-  
of the  
ls are  
29/32  
drills  
v cost  
hat of  
made  
f pre-  
ich is  
desired  
duced  
g in-  
onven-  
re.  
of  
eth  
f Buf-  
t com-  
to the  
Soci-  
d No-  
name  
ty of  
2, the  
Engi-

ound  
ectly  
e as  
to the  
al as

**for ACCURATE GRINDING**  
**... Plunge Cut or Traverse**



**No 10 - 6" x 18"**  
**No 12 - 6" x 30"**  
**Electric-  
Hydraulic Type  
PLAIN GRINDING  
MACHINES**

  
Investigate the possibilities of  
these machines for **profitable**  
**production** on your work.  
**BROWN & SHARPE MFG. CO.**  
PROVIDENCE 1, R. I., U. S. A.



**Convenient Time-saving Controls**  
— both Manual and Semi-Automatic  
... aid quick set-up ... promote **fast**  
production

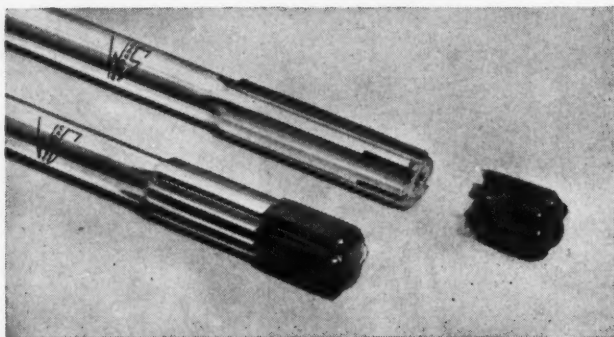
**Accurate Table Reversal**  
to unusually close limits

**Smooth Vibrationless Operation**  
at all table speeds ... including those  
slow speeds used for fine wheel truing

**BROWN & SHARPE**

## Plastic Covering for Carbide-Tipped Tools

Damage to carbide-tipped tools in transit or in the stock-room or tool-room bins should be considerably reduced by a new protective device now used by the Wendt-Sonis Co., Hannibal, Mo. The protection consists of applying a strong



Carbide-tipped Tools Protected from Damage by New Plastic Covering

plastic coating to each tool tip immediately after final inspection at the plant. This hard and durable covering remains in place until inspected by the purchaser. It can then be slipped back over the tool tip to provide permanent protection while the tool is in the bin. Although the covering is air- and moisture-proof, it will not leave any gummy residue on the working surfaces when removed from the tip.

\* \* \*

## Value of Incentive System Proved by Lincoln Electric Co.

In distributing the incentive pay checks earned by approximately 1100 workers of the Lincoln Electric Co., J. F. Lincoln, president of the company, emphasized that this year-end distribution is not a gift. On the contrary, it is money earned by the remarkable productivity of the employees.

While this incentive system makes the annual pay of Lincoln employees high, compared with that received by workers in many other factories, Mr. Lincoln stated that the production rate per man is three times the national average. He believes that other industries not only could successfully adopt this incentive pay plan but he believes that they *must* adopt some method of paying for what a man produces. Otherwise, he says, American industry and the country's standard of living will decline. The method of paying for time spent in the factory he considers meaningless and outmoded. It is what is produced that counts, and the cost per piece made is the real measure of a man's value.

## War Production Must Continue at a High Level

It is unfortunate that statements emanating from high military sources with regard to the early ending of the war have had the effect, in many instances, of reducing the monthly output of essential war materials. As we have come to realize during the last few weeks, the war is far from over. The military authorities need an ever increasing amount of the larger sizes of shells, heavy guns, planes, and transportation equipment.

To be sure, there have been cutbacks on some items of which we have an adequate supply. It should be remembered, however, that the Ordnance Department requires thousands of different items for the war program, and that a sufficient supply of one of these items does not outweigh an inadequate supply of another. There must be an adequate production of every one of the types of shells, weapons, and means of transportation required.

Possibly the military authorities did not anticipate to the degree that would have been desirable the extreme demand that the war would place on certain types of artillery and other war equipment. The men in authority cannot be censured very severely for this, because the shifting demands of modern warfare and the rapid changes in the conditions make advance planning extremely difficult. Some mistakes have obviously been made, but fair-minded observers point out that they are not impressed by the number of mistakes, but rather, considering the vastness of the campaigns, by the fact that so few serious mistakes have been made that would hamper the plans for our war effort.

The importance of war workers staying on the job cannot be overemphasized. It is too early to begin to shift to civil or peacetime employment, and it is no time to let down on the war effort by absenteeism—not to mention strikes, which at this time are nothing less than crimes against the nation, even if they have not been legally so defined.

\* \* \*

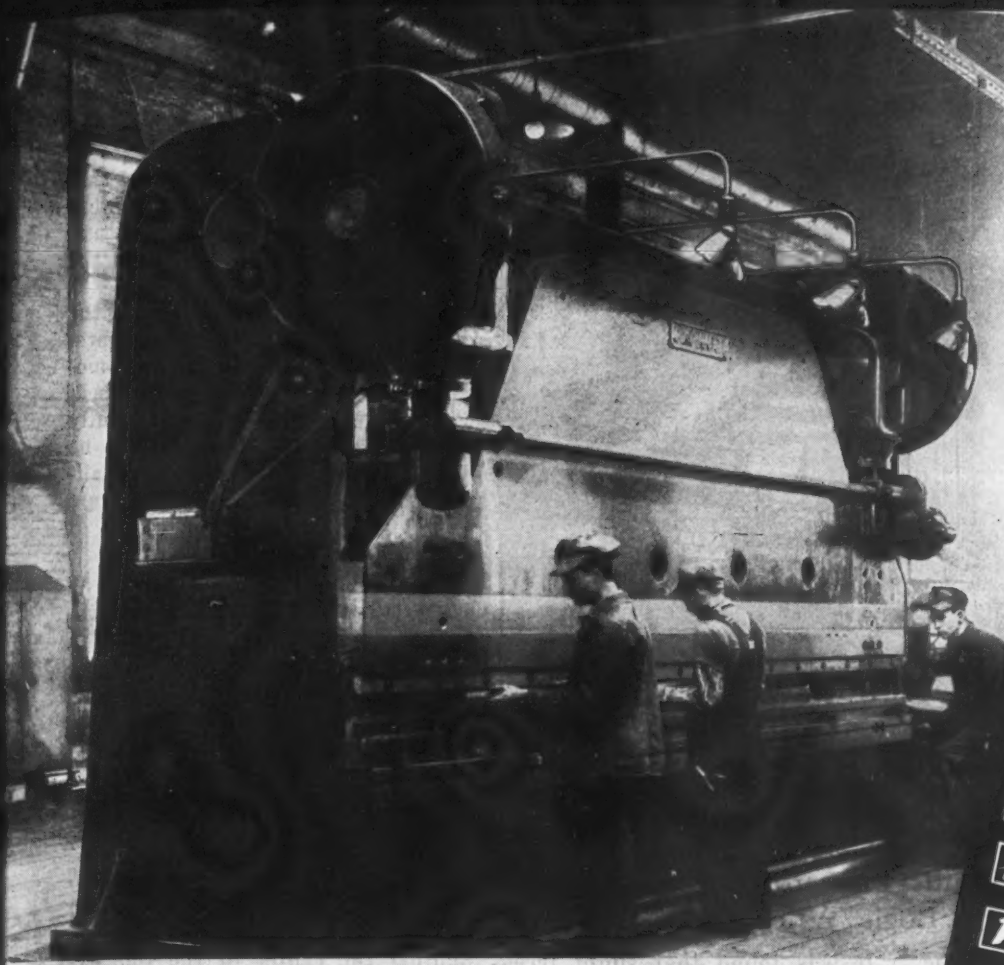
## Courses in Production Supervision

St. John's University, 75 Lewis Ave., Brooklyn 6, N. Y., offers two courses in production supervision, beginning on February 5. These courses are tuition-free, and will be given evenings at 96 Schermerhorn St., Brooklyn, N. Y. The courses are limited to people who are already employed in an essential industry and who have proper qualifications for benefiting by the courses, one of which deals with cost control through time study, and the other with current industrial personnel problems. Further information can be obtained from the University.

ue  
ting  
the  
, in  
put  
ome  
r is  
need  
s of  
tion  
ome  
It  
ord-  
dif-  
t a  
not  
ere  
e of  
ns-

nti-  
sir-  
uld  
var  
be  
the  
the  
nce  
kes  
ob-  
sed  
id-  
act  
ade  
ort.  
on  
too  
em-  
the  
ion  
an  
not

ok-  
on  
ese  
en-  
he  
dy  
ho  
he  
rol  
nt  
or-



# Does them all ➡

- ✓ Threshold Plates
- ✓ Roof Sheets
- ✓ Ceiling Supports
- ✓ End Filler Clips
- ✓ Running-Board Brackets
- ✓ Water-Tank Shrouds
- ✓ Formed Angles, Tees and Channels

A great variety of punching and forming jobs are done by Cincinnati Press Brakes in railroad car shops. Their flexibility—ease and economy of change-over—make them extremely popular and profitable.

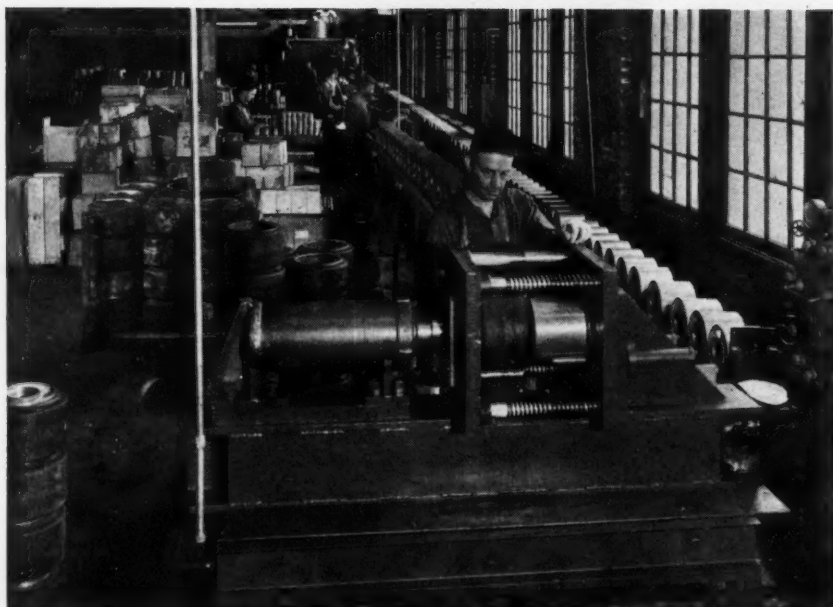
In the shop illustrated, the Cincinnati Brake is handling work ranging from the production of thirty  $\frac{1}{8}$ " x 2" clips a minute

to forming  $\frac{3}{8}$ " steel plate sixteen feet long. Such adaptability keeps Cincinnati Press Brakes busy day in and day out.

Write for Catalog B-2, the book of many suggestions.

## THE CINCINNATI SHAPER CO.

CINCINNATI OHIO U.S.A.  
SHAPERS · SHEARS · BRAKES



Hydraulic Press which Saved Weeks of Production Time in Assembling Tires on Amphibious-tank Bogie Wheels

### Homemade Hydraulic Press for Assembling Tires on Bogie Wheels

Combining a standard hydraulic cylinder with a punch press die set helped the Bryant Heater Co.—one of the Dresser Industries—out of a tight spot and added a piece of production equipment at half the cost of a conventional hydraulic press. A press of 37 1/2 tons capacity was needed in one of the Cleveland plants for mounting tires on amphibious-tank bogie wheels. An improvised press was placed in operation in three days.

This homemade press was built up by mounting a standard 37 1/2-ton hydraulic cylinder horizontally on a steel I-beam, as illustrated. The ram of this cylinder was fixed to an 18-inch square steel plate, to which the die half of a standard 20-inch die set was bolted. The platen half of the die set was bolted to a second 18-inch square plate. This plate was welded and bolted at right angles to the I-beam, and reinforcing wedge plates were added. The entire assembly was then mounted on a table beneath which a hydraulic pump, reservoir, and motor were placed.

To support the wheel parts while being pressed together, two pins were fixed in each plate in such a manner that when the die closed through the action of the hydraulic ram, the pins receded through the plates. A spring returned them when pressure was released.

thousandths of an inch, so that when the two wheel parts were pressed together, the line of thrust would lift the assembly from the supporting members.

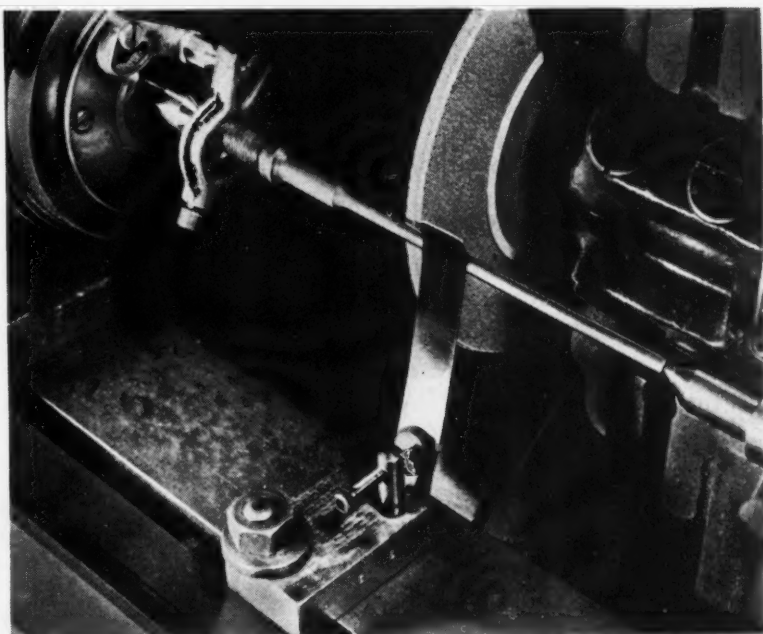
Designing the machine with the hydraulic cylinder in a horizontal position provided economy of motion. Also, since only the 18-inch plates were fastened permanently to the machine, the die set can be removed and the press made available for other jobs.

\* \* \*

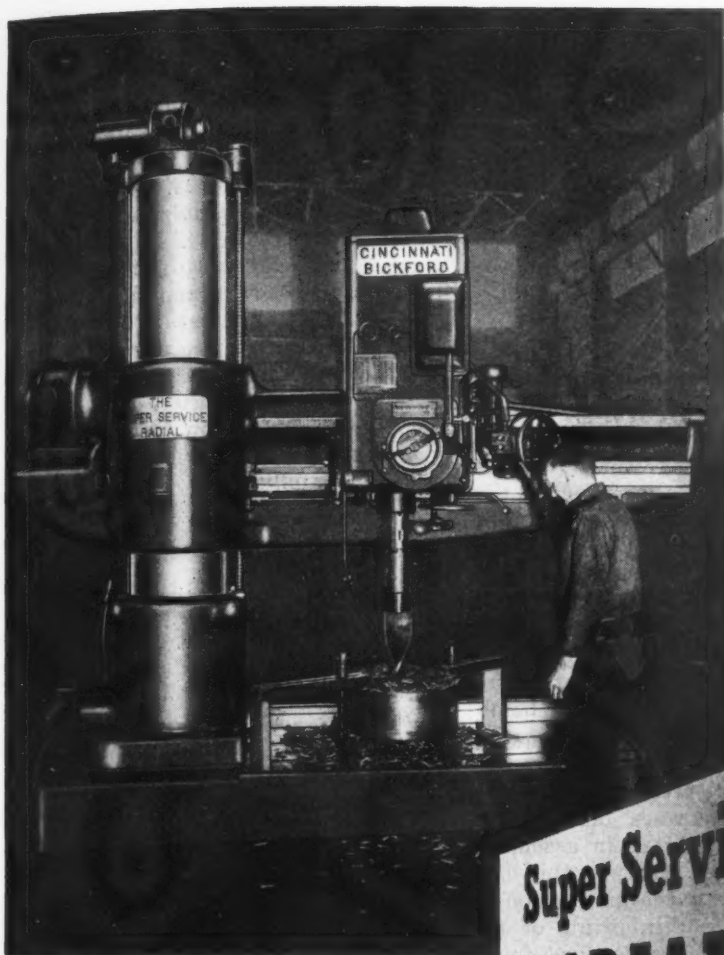
### Spring Rest Steadies Small Rods while Grinding

A spring steadyrest, devised by H. Rennie of the Punching, Tool, and Die Division of the General Electric Co.'s Schenectady Works, successfully eliminated vibration while grinding rods of small diameter to very close tolerances.

An upright spring is attached to a base piece by means of a bridge clamp, so that the spring rests against the center of the rod, exerting a certain pressure and thereby supporting the work. The bridge clamp is used to avoid weakening the spring by making holes through it. The screw used to adjust the pressure of the spring has a spherical end, consisting of a steel disk and a leather pad which supplies a cushioning effect.



Arrangement by Means of which a Spring Rest Steadies a Small Rod while Grinding

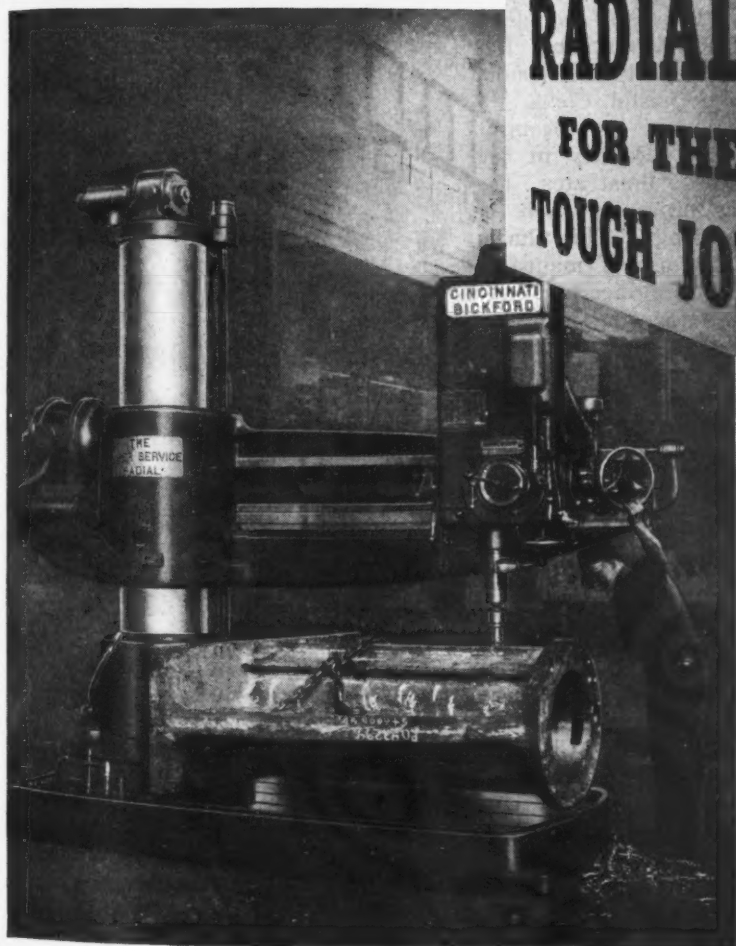


**F**OR precision workmanship within their respective ranges, no work is too heavy or too difficult for the Super Service Radials at the plant of the Erie Foundry Company at Erie, Pa. In this plant the features of these efficient machine tools are applied to greatest advantage for

speedy and accurate production . . . they will similarly assure improved workmanship in your plant. Features include • easy handling (operator finds all controls centralized for instant accessibility) • power and speed are maintained under heavy load • positive feed clutch • compensating depth gage • constant direction of spindle rotation • instant spotting with power rapid traverse • ample safety devices

• ultra-rugged construction. Write for latest literature and illustrated bulletins on the complete line of Super Service Radials.

**Super Service  
RADIALS  
FOR THE  
TOUGH JOBS**



**THE CINCINNATI BICKFORD  
TOOL COMPANY**

OAKLEY, CINCINNATI 9,  
OHIO, U. S. A.

## Water-Cooled Welding Fixture

The revolving, circular welding fixture shown in the accompanying illustration has a unique water cooling arrangement which permits the movable top portion of the fixture to be safely revolved by hand, regardless of the heat to which it is subjected during welding. The entire fixture unit, designed by an



Welding Fixture with Water Cooling Arrangement Designed to Permit Rotation of Work by Hand, regardless of Heat Generated by Welding Operation

operator at the Lincoln Electric Co.'s plant in Cleveland, Ohio, was constructed by arc welding.

This simple metal-fabricating process made possible the desirable water-cooling feature and required a minimum amount of materials. A 30-inch length of 7-inch pipe serves as the main upright and is welded to a disk-shaped plate 1/2 inch in thickness, which forms the base. Two pieces of standard 2-inch channel are welded to the bottom edge of the base to provide added rigidity.

The top movable section of the fixture is composed of a steel column with a dish-shaped circular member welded inside the collar at the top for retaining the cooling water. The top plate, which comprises the working surface, is made of a heavy circular piece of copper, fused to the collar by intermittent welds to allow a space between the top plate and the collar for the diffusion of heat and to permit water to be poured into the structure as needed for cooling.

The fixture revolves on a ball-bearing race, welded to the main upright. The bearings of the fixture are seated on the under side of the top plate. This arrangement permits the top of the fixture, which holds the work, to be easily turned by hand during the welding process.

\* \* \*

## Motion Pictures on Care of Ball Bearings

The New Departure Division of the General Motors Corporation has released a film to instruct industrial employees on the care and handling of micro-instrument bearings. This 16-millimeter film, with sound track, illustrates graphically the extreme care used in the inspection of and final operations on small ball bearings made for bomb-sights and other aircraft instruments. The purpose is to impress those who receive the bearings with the importance of handling them with equal care in assembly.

Concerns who can use this film to advantage for the instruction of employees can obtain prints of the film free of charge for use for a limited time. Requests should be directed to the Advertising Department, New Departure Division, General Motors, Bristol, Conn.

The company has also brought out another film, "Quality in the Making," which illustrates the manufacturing processes used in making ball bearings. This film is available for the use of manufacturing plants, engineering societies, and engineering colleges. Both films require approximately twenty minutes to show.

\* \* \*

## Material-Handling Manufacturers Organize Trade Association

The Material Handling Institute, with headquarters at 208 S. La Salle St., Chicago 4, Ill., has been formed by leading manufacturers in that field. Lawrence J. Kline, of the Mercury Mfg. Co., Chicago, has been elected to serve as the first president of the organization. J. Faulkner Thomas, of the Thomas Truck & Caster Co., Keokuk, Iowa, has been elected vice-president, and

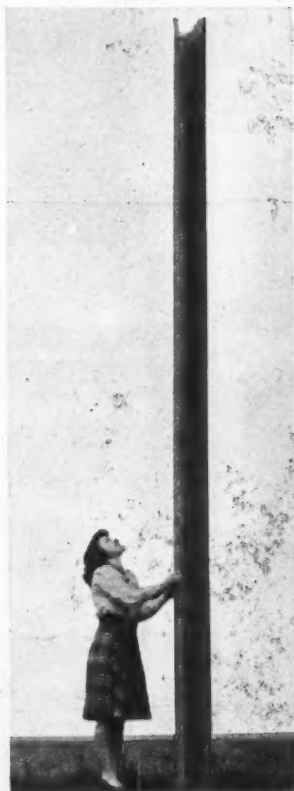
Walter S. McCann, who has had long experience in trade association work, will serve as acting secretary-treasurer. There are about 165 concerns engaged in this field, of which more than 35 are already members of the organization.

The membership will be of three classes—(1) an active membership group composed of manufacturers whose major interest is in this field; (2) an associate membership group composed of manufacturers with a secondary interest in the field; and (3) a fellow membership group of individuals interested in material handling.

\* \* \*

Some of the large four-engine airplanes being built today use as many as 3500 ball and roller bearings each.

This is Believed to be the Longest Molded Plastic Product Ever Manufactured. It is a 17-foot Radar Housing Made by the General Electric Plastics Division for the Douglas Aircraft Co. The Low-pressure Molded Housing is Constructed with a Glass Fabric Filler



# CARBOLOY

## *Tools for Roller Turners*

FASTER STOCK REMOVAL

MORE UNIFORM SIZE

SMOOTHER FINISH

EXTRA LONG TOOL LIFE

*Available for Gisholt • Jones & Lamson • Warner & Swasey*  
TURRET LATHES

When machining bar stock with roller turners, you'll step up output and step down costs with Carboloy Roller Turner Tools.

Designed for extra long tool life and rapid regrounding, Carboloy Roller Turner Tools remove stock faster, hold more uniform size, and produce a better finish.

Carried in stock ready for prompt deliveries. Standard styles for Gisholt, Jones & Lamson, and Warner & Swasey Turret Lathes. For top production, and maximum economy, put Carboloy Roller Turner Tools on your jobs. Write for catalog GT-175R.



STANDARD

# CARBOLOY

TOOLS

TRADE MARK

CARBOLOY COMPANY INC. • 11147 E. 8 MILE BLVD. • DETROIT 32, MICHIGAN  
Chicago • Cleveland • Houston • Los Angeles • Milwaukee • Newark • Philadelphia • Pittsburgh • Thomaston, Conn.

# Shop Equipment News

*Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market*

## Michigan "Shear-Speed" Gear-Cutting Machine

A machine designated the "Shear-Speed," which cuts all the teeth of a gear simultaneously using radially fed formed tool blades having a shear cutting action, is being introduced on the market by the Michigan Tool Co., 7171 E. McNichols Road, Detroit 12, Mich. This machine is designed for the rough- and semi-finish cutting of gears up to 4 inches in diameter and 2 inches face width at the rate of 60 to 100 or more gears per

hour, depending on the gear being cut. One of the objectives in developing this machine was to bring the speed of the gear-cutting operation up to the level set by modern gear-shaving or gear-finishing machines, so that only one gear-cutting machine would be required to keep the gear-finishing machine in continuous operation.

In addition to the tremendous increase in production capacity, this new machine also has the ad-

vantage of operating with a balanced cutting pressure around the circumference of the gear blank. The cutting blades can be ground so that they retain their original cutting action and form.

The machine is exceptionally easy to operate, no particular skill being required. The gear blanks in which the teeth are to be cut are merely placed on the work-holder, chucking being included in the automatic machine cycle. After placing the gears in the holder, the operator presses a button to start the machine, after which the gear-cutting cycle is completed, the cut gear being automatically returned to the loading point and released for removal, so that another blank can be put in its place.

The cutting action of the machine is as follows: When the gear blank A, Fig. 1, is automatically clamped in place, the head B of the machine, containing the cutter-head C, also shown in Fig. 2, is automatically lowered and locked in the cutting position. The work is then reciprocated vertically. At the beginning of each upward stroke, all blades—one for each tooth space, as shown at D, Fig. 2—are advanced or fed radially an equal amount into the work. On the return stroke, the blades are retracted slightly, as on conventional gear-shapers, to provide clearance for the tools. The amount that the blades are fed into the work at each stroke is adjustable. Correct sizing of the work is also controlled automatically and is adjustable.

A "jog" or inching control is provided for making set-up adjustments when changing from one job to another. There are also means for adjusting the speed of vertical reciprocation and the length of stroke. To sharpen the blades or to change over for cutting another type of gear, the entire inner cut-

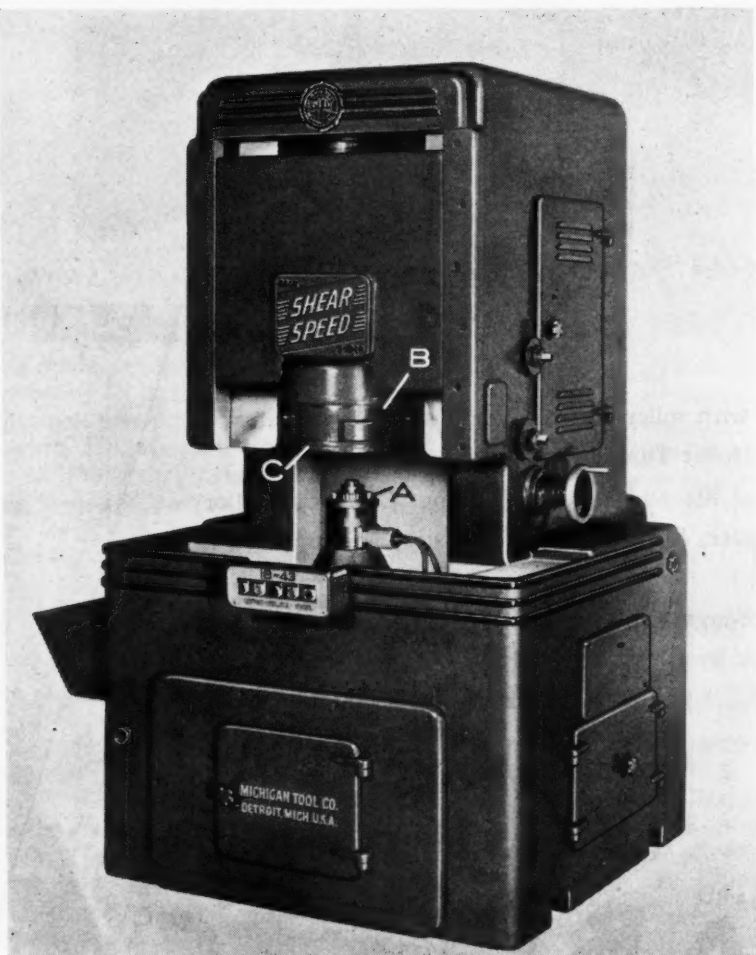
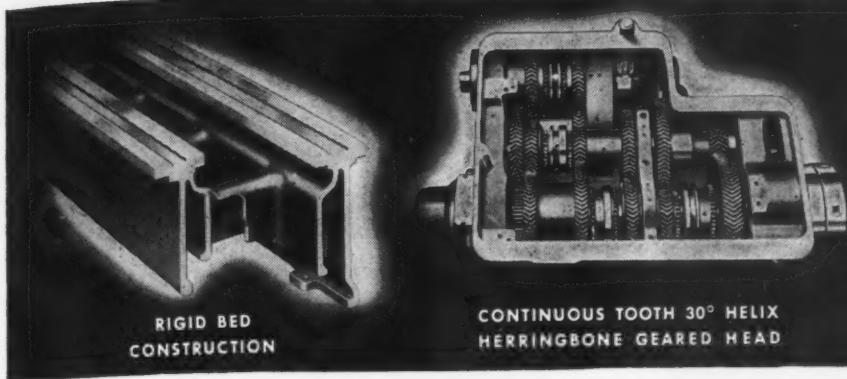


Fig. 1. "Shear-Speed" Gear-cutting Machine Developed by the Michigan Tool Co.



RIGID BED  
CONSTRUCTION

CONTINUOUS TOOTH 30° HELIX  
HERRINGBONE GEARED HEAD



Photo courtesy The Yoder Co.

## For all around utility **SIDNEY LATHES**

● This battery of Sidney Lathes at a prominent midwestern plant shows how these rigid machines are being used in hundreds of plants to meet precision demands on an exceptionally wide range of work.

Sidney Lathe construction is particularly rigid. For example the bed differs from conventional design in that it has four walls with cross girts spaced at 12 inch intervals. This construction resists deflections and twisting strains and eliminates vibration.

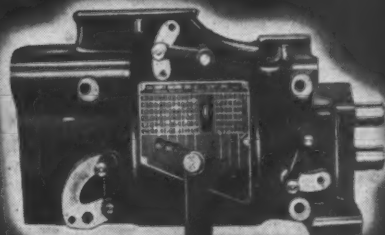
Thus in this and many other ways Sidney Lathes assure strength—smooth flowing power—high productivity on a vast number of turning jobs of all kinds.

Bulletins on all sizes available.

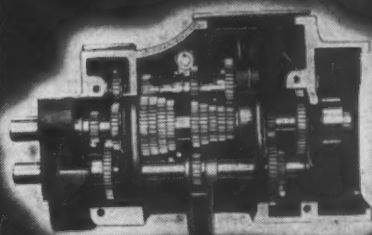


**The SIDNEY MACHINE TOOL Company**  
*Builders of Precision Machinery*  
**SIDNEY** **ESTABLISHED 1904** **OHIO**

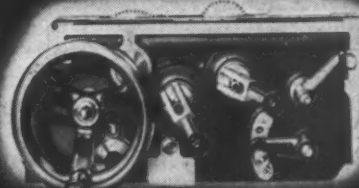
**Sidney**  
**40TH ANNIVERSARY**



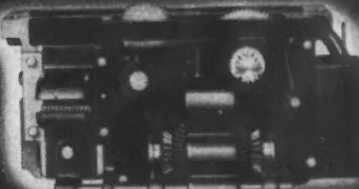
FRONT VIEW OF GEAR BOX



REAR VIEW OF GEAR BOX



FRONT VIEW OF DOUBLE WALL APRON



REAR VIEW OF DOUBLE WALL APRON



SIDNEY COMPOUND REST

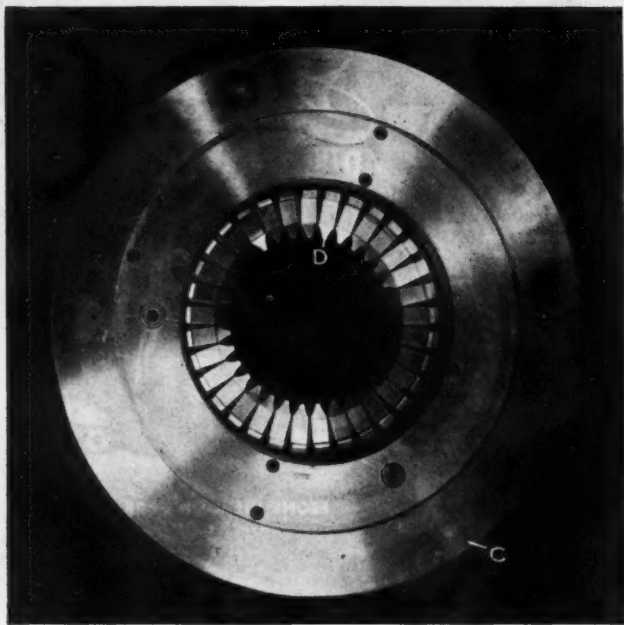


Fig. 2. Gear Tooth Cutter-head Used on Machine  
Shown in Fig. 1 for Cutting Spur Gears



Gear-tooth Eccentricity and Parallelism Checking  
Device Built by National Broach & Machine Co.

ter-head assembly, Fig. 2, is quickly removed as a unit, permitting insertion of another cutter-head with a minimum of idle machine time.

Shoulder type gears can be handled easily on this machine, since its action is similar to that of a shaper cutter. The machine can also be adapted for cutting helical gears. Safety of operation and exceptional rigidity are outstanding features of the machine. Sufficient chip clearance has been provided to take care of the large volume of

chips produced by the exceptionally high rate of metal removal. Cutting fluid from a tank in the base of the machine is supplied under relatively high pressure for washing the chips from the work.

Special care has been taken to provide accessibility throughout the machine for making adjustments or repairs. All control circuits, both hydraulic and electric, are easily accessible. Large openings in the machine base and column facilitate any necessary adjustments of the mechanism. ...71

sired. Any change of the pointer from the zero position indicates eccentricity.

The head on the opposite side of the work-gear, for checking parallelism, is built with a sensitive slide which is supported on a ball-bearing track. An 8-inch slotted rail on the forward side of the slide carries a contacting finger which actuates a dial indicator at its base. The slide can be reciprocated a maximum distance of 3 inches across the face of the tooth by means of a handwheel at the side of the checking head.

When the contact finger is engaged with a gear tooth at one end and the indicator set at zero, any variation in the indicator reading as the finger is drawn across the tooth surface to its opposite end represents an error in parallelism. This head can also be used for checking the amount and position of crown on an elliptoid tooth. ...72

### Device for Checking Spur Gear Teeth

A new device for checking spur gears for eccentricity and tooth parallelism has just been announced to the trade by the National Broach & Machine Co., 5600 St. Jean, Detroit 13, Mich. This equipment can be furnished in three sizes for checking teeth of gears having maximum pitch diameters up to 12, 18, and 24 inches. It is also available in special bed lengths for gears with integral shafts.

The device consists of a rigid base with a top finished to close tolerances, such as is required for a toolmaker's flat, and which has two V-shaped keyways crossing each other at an angle of 90 degrees. One groove is for the adjustable work-holding centers, and the other for the checking heads,

one checking head being positioned on each side of the work-gear. The eccentricity checking head has a spring-loaded retractable spindle with an interchangeable conical contact point selected to suit the pitch and pressure angle of the gears to be checked. The rear of this spindle carries an arm which actuates the spindle of a dial indicator mounted on the head.

The head is set so that the contacting point engages the gear tooth either at the pitch line or at the root under spring pressure. After the head is set, the indicator is adjusted to show a zero reading, following which the spindle is retracted to permit indexing the gear. The gear can be indexed for as many indicator readings as de-

### General Electric Weld and Sequence Timer

A new weld and sequence timer designed to provide the various time and current adjustments required for welding heavy sections of air-hardenable steels has been brought out by the Industrial Control Division of the General Electric Co., Schenectady 5, N. Y. Although this timer, known as Type

*To Wish Sincerely is to Pray  
To take our proper place in a land at peace,  
A world where children play and Men may work  
Divorced from Fear,  
Where each may know the joy of a task well done  
And be rewarded for his share,  
Such is our Wish*



**GISHOLT MACHINE COMPANY.**

**MADISON, WISCONSIN**

CR7503-F170, is especially designed for use with a G-E ignitron contractor and a heat control panel, it can also be employed in combination with most of the spot-welding controls made by the General Electric Co. which include the phase-shift method of heat control. ....73

### Cross Special Three-Station Transfer Type Drilling Machine

The Cross Co., Detroit 7, Mich., has developed a transfer type three-station machine for drilling, countersinking, and tapping assembly holes in the bowl face of front and rear axle housings for 4- and 6-ton heavy trucks and for simultaneously drilling and tapping two grease drain holes in the sides of the bowls. The machine has three-10-H.P. independently driven multiple-spindle heads mounted on a common base with a table that indexes the work from station to station.

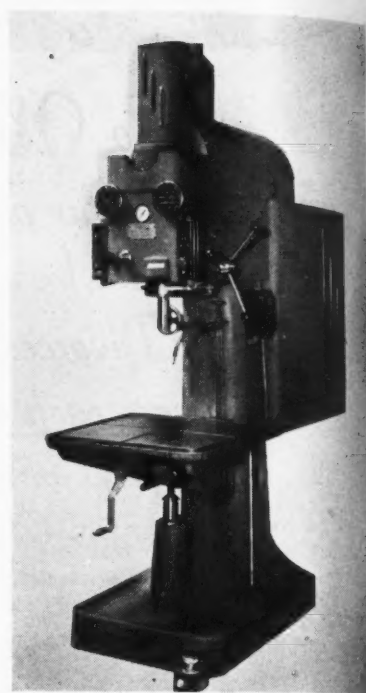
The table carries a work-holding fixture which is arranged to accommodate both front and rear axles. The multiple spindles are arranged in the heads to permit working on the two different sizes of bowl faces. Two single-spindle units at the left and below the drilling and tapping heads operate simultaneously in processing the two bowl holes. All elements of the machine operate automatically by electric push-button control.

In the push-button operating sequence after the work is loaded, a locator swings over and positions

the casting in the fixture. Power clamping is then applied to the work, after which the locator swings back to its former position. In three successive indexing movements, the table carries the work under the heads for drilling, countersinking, and tapping, and returns it to the loading position. Production at 80 per cent efficiency is six axle housings an hour. Only one unskilled operator is required to run the machine. ....74

### Cleveland Tapping and Threading Machine

The tapping and threading machine here illustrated was developed by the Cleveland Tapping Machine Co., 1725 Superior Ave., Cleveland 14, Ohio, for one of the leading manufacturers of aircraft parts. This machine is lead-screw controlled, and yet has rapid approach and retraction of the spindle. The lead-screw assembly is never disengaged from the spindle. The entire lead-screw assembly slides in scraped ways, and has a



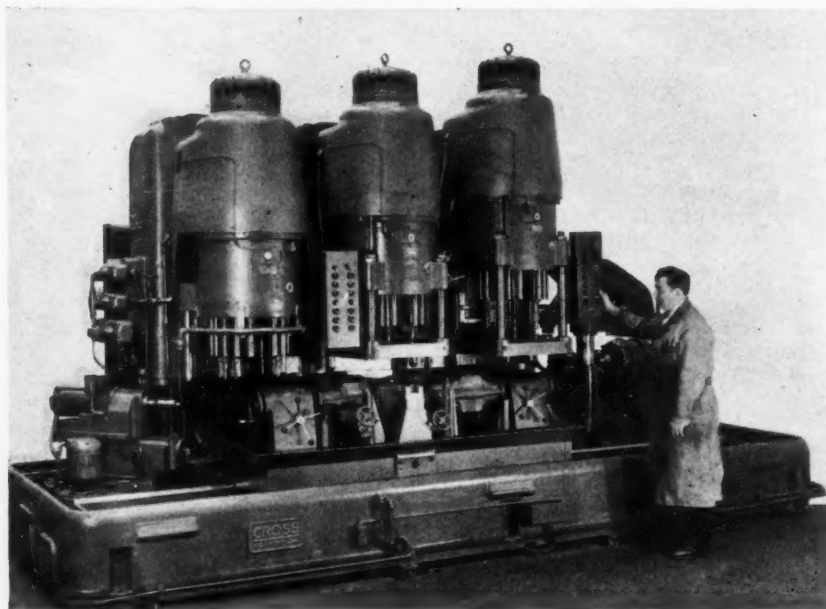
Cleveland Tapping and Threading Machine

specially designed locking device to insure highly accurate work.

The rapid approach and retraction of the spindle are controlled by two air cylinders which are so arranged that they exert no air pressure on the spindle when the tap is cutting. The rapid approach can be set to stop within 0.010 inch of the hole to be tapped. The rapid retraction becomes effective the instant the tap leaves the work. The tap is removed at twice the tapping speed. With this arrangement it is possible to tap as many as 2000 holes per hour.

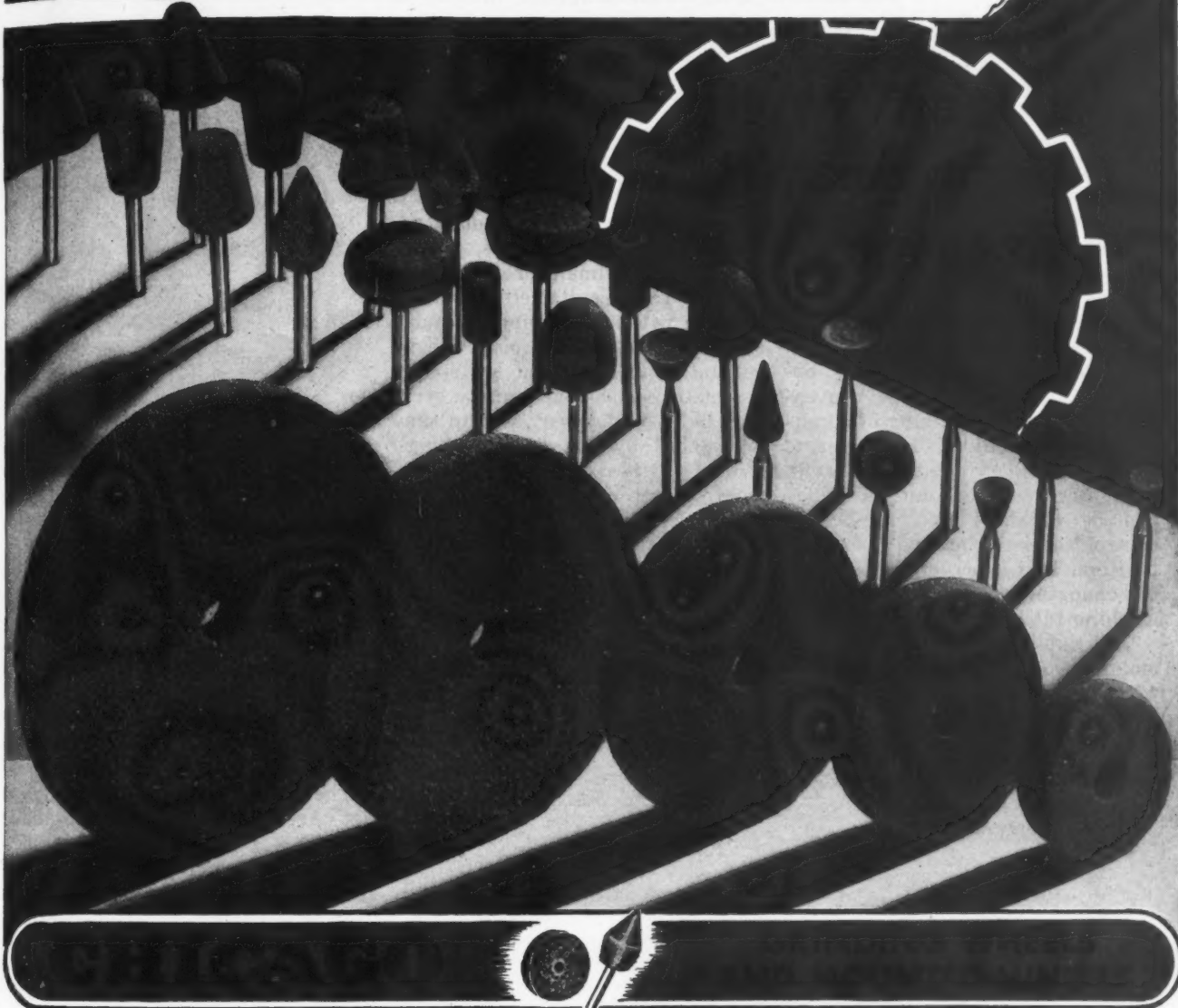
The reversing mechanism is mounted on the drive-shaft, and not on the tapping spindle. It is actuated by two opposed bi-metallic clutches, one operating the forward or tapping cycle and the other the reversing cycle. The positive action of this clutch controls the vertical travel of the spindle within limits of 0.005 inch, and the rotation timing of the spindle is held to 1/10 revolution. This makes the machine especially adapted for blind-hole tapping.

Stepless speed adjustment is available within a range of 40 to 400 R.P.M. The machines can be furnished with special quick-adjustable variable drives to meet requirements for higher speed ranges. The motor revolves in one direction, and does not reverse for



Special Three-station Transfer Type Machine Made by the Cross Co. for Drilling, Countersinking, and Tapping Operations

# FORWARD



● Geared to the precision demands of war, Chicago Wheels have been a potent force in smashing bottlenecks—cutting down rejects—speeding production to an all-time high.

Constantly tested, constantly improved—Chicago Wheels produce finishes so perfect they pass exacting surface analyzer tests, so accurate they can be measured in micro inches.

Production of civilian goods will demand the same precision finishing methods.

Keep pace with Chicagos, the Wheels of Progress!

## CHICAGO GRINDING WHEELS

Anything up to 3" in diameter in various grains and bonds, including FV, the sensational new bond with a pedigree.

## CHICAGO MOUNTED WHEELS

Shapes and abrasive formulas to take care of every job of internal or external finishing.

## TRY ONE FREE!

So you'll know what they can do, we will send a test wheel. Tell us material you'd like to finish and size wheel required.

Send Catalog. Interested in ☐ Grinding Wheels

☐ Mounted Wheels.

☐ Send Test Wheel. Size.....

Name.....

Address.....

MR-1

MACHINERY, January, 1945—213

the tapping cycle. The machine has a tapping capacity range of from 3/8 inch to 3 inches in steel, and will tap either right- or left-hand Class 3 fit threads on a production basis.

The rapid approach can be set to thousandths of an inch for any length of approach stroke up to 5 inches. The depth control can be set within a range of from 1 inch

to 6 inches. A gage is provided on the face of the machine for adjusting pressure on the clutch to exactly suit the size of tap or die being used. The sensitive clutch is designed to slip when any additional torque is applied, in order to safeguard the tap and work. Provision is made for operating the machine either manually or automatically. \_\_\_\_\_75

### Cincinnati Hypro Drive Boring Mill

The Cincinnati Planer Co., 3120 Forrer St., Cincinnati 9, Ohio, has just developed a Hypro table drive for its vertical boring mill. This new drive is designed to meet the need for higher production on work requiring boring and turning operations. It replaces the conventional gear-shift changing of speeds by finger-tip control. The complete range of table speeds ordinarily encountered under cutting loads can be obtained by push-button control from the normal operating position. This is accomplished without changing gears or stopping the machine table.

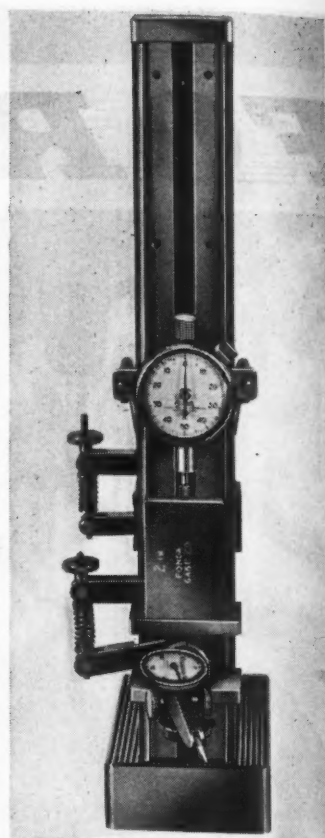
The multi-point, fine-increment motor rheostat used in conjunction with this drive insures maximum production by making available table speeds exactly suited to the

work being done. Continuous adjustment of table speeds, as required for maximum production on work of varying diameter, is made possible without stopping the table or interrupting the cut. Heavy cutting requirements at low speeds are met by a back-gear drive operated by a single lever. Set-up time is reduced by the fine "inching" control provided for the table movement in both directions.

Complete control of all motors from a single accessible pendent station, together with the elimination of clutch and brake shifting, serves to lessen operator fatigue. A large easily read dial mounted on top of the boring mill frame shows at a glance the actual table speed. Pre-set table speeds can also be instantly determined. \_\_\_\_\_76



Cincinnati Boring Mill Equipped with Hypro Drive



Inspection Height Gage Made by F & H Mfg. Co.

### F & H Inspection Height Gage

The F & H Mfg. Co., 10338 Gratiot Ave., Detroit, Mich., has developed a new type of inspection height gage which is being used to speed up inspection and insure greater accuracy at a substantial saving in inspection costs. In using this height gage, three simple steps are required: First, set the lower indicator at the desired height on the work to be inspected. Second, determine the height to be tested; then select a gage-block corresponding to the desired height and place it on the platform. Lower the top indicator onto the gage-block and adjust until the upper indicator reads zero. Third, remove the gage-block and adjust the platform upward against the top indicator until the reading is zero. This gives the desired height dimension and the checking is done with the lower indicator. In this way, the desired height is accurately measured on the piece being inspected, no paper figuring being required.

For laying out work, the bottom

*worthwhile  
savings...*



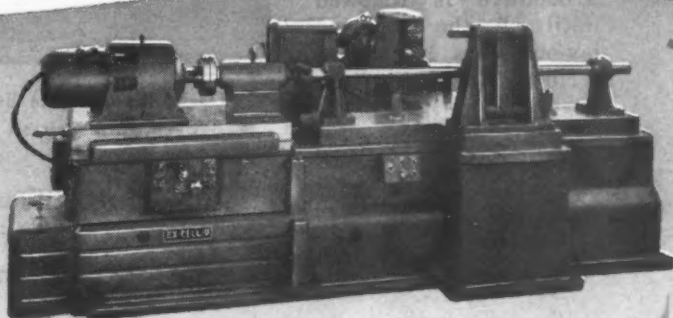
# that EX-CELL-O's pioneering in *Precision* machining now makes possible to you!

TO MAKE sure of a low "unit cost" on high production jobs you're planning for *tomorrow*, you should get in touch with Ex-Cell-O *today*. For many years Ex-Cell-O has been foremost in the designing and construction of special multi-purpose and semi-standard machines for America's leading industries, both small and large. A quarter of a century of *precision engineering* has gone into Ex-Cell-O experience. This "know how" has made the Ex-Cell-O name well and favorably known throughout the industrial world. The advantages of this practical background are available to you *now*, when the pressure of post-war competition is fast approaching. In making your production plans for the immediate future, give early consideration to Ex-Cell-O multi-purpose machines. They frequently perform numerous operations in one setting of the work and often bring a substantial increase in the number of parts hourly produced, also improved quality and lower unit cost.

**EX-CELL-O CORPORATION • DETROIT 6**



Above: Bulletin on Ex-Cell-O Precision Way Machines For Higher Production and Improved Accuracy. Write for free Ex-Cell-O Bulletin 31631.



Above: Ex-Cell-O Special Style 58 Two-Way Machine for finish boring center and both ends of differential transmission case (of chrome nickel iron—shown in two views). This Ex-Cell-O machine combined several operations formerly necessary, and greatly increased production.

Below: Ex-Cell-O method of bolted construction. Linked in this manner are the wing sections of the machine that carry the spindles, and the center pad section that carries the work fixture. This Ex-Cell-O feature of construction provides not only added strength and rigidity but greater flexibility. When desired to machine a part of different dimensions the center section can easily be removed and a section of different size substituted.



Where increased production, high accuracy, and greater economy through multiple operations are required...consult EX-CELL-O.

## EX-CELL-O makes:

SPECIAL MULTIPLE WAY-TYPE  
PRECISION BORING MACHINES

SPECIAL MULTIPLE PRECISION  
DRILLING MACHINES

PRECISION BORING, TURNING  
AND FACING MACHINES,  
AND FIXTURES

PRECISION CYLINDER BORING  
MACHINES

PRECISION THREAD GRINDING  
MACHINES

PRECISION LAPPING MACHINES

PRECISION BROACH SHARPENING  
MACHINES

OTHER SPECIAL PURPOSE  
MACHINES

BROACHES AND BROACH  
FIXTURES

HYDRAULIC POWER UNITS

GRINDING SPINDLES  
DRILL JIG BUSHINGS

CONTINENTAL CUTTING TOOLS  
TOOL GRINDERS

FUEL INJECTION EQUIPMENT

R. R. PINS AND BUSHINGS

PURE-PAK PAPER MILK BOTTLE  
MACHINES

PRECISION AIRCRAFT AND  
MISCELLANEOUS  
PRODUCTION PARTS

indicator is removed and replaced by a scribe. The platform is then adjusted until the scribe rests properly on the gage-block, giving the desired first dimension. The next dimension is obtained by placing the correct gage-block on the platform and adjusting the top indicator to the gage-block. The gage-block is then removed and the platform adjusted to show the same reading on the upper indicator. This procedure is followed until all the required lay-out lines have been scribed. The base of the gage is 5 inches in diameter, and the gage column is 12 1/4 inches high. The gaging platform is 2 inches wide, and has a vertical movement of 11 inches. \_\_\_\_\_77

### Ohio Differential Variable-Speed Drive

A variable-speed drive designed for applications not previously covered by any mechanical or electrical device has been brought out by the Ohio Gear Co., 1331 E. 179th St., Cleveland, Ohio. The new drive consists of two mechanical differential mechanisms and a standard variable-speed reducer. Using an 1800-R.P.M. squirrel-cage motor as a source of power, an output speed range of from 0 to 800 R.P.M. in one direction, or a range of from 400 R.P.M. forward to 400 R.P.M. in reverse, can be obtained. A feature of this drive is that the torque remains constant throughout the entire range.

The unit shown in the illustration, designated No. T3, consists of a Link Belt PIV No. 3 and two mechanical differential mechanisms. The torque capacity of this drive is 750 inch-pounds. Other units of this type are available in torque capacities up to 2100 inch-pounds throughout the same speed ranges. The bevel gears of the differential mechanisms are made of alloy steel, casehardened, and mounted on anti-friction bearings. The worms are hardened and ground and the worm-gears are made of bronze. \_\_\_\_\_78



"Desk" Type Lathe Brought out by the Elgin Tool Works for Precision Shop and Tool-room Work

### Elgin "Desk" Type Lathe for Tool-Room and Precision Shop Work

An improved "desk" type bench lathe designed to obtain greater versatility and maximum operating convenience has been brought out by the Elgin Tool Works, 1770 Berteau Ave., Chicago 13, Ill. The base of this lathe affords generous leg room and has a foot-rest for the operator when seated. Ample drawer space for storage has also been provided.

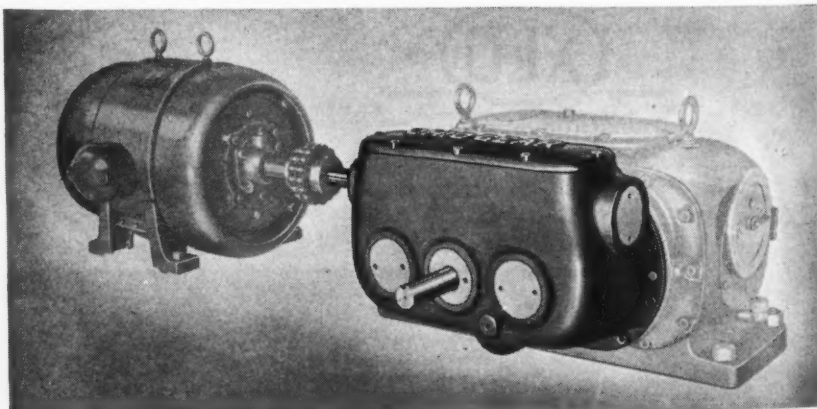
The range of the variable-speed drive has been expanded both upward and downward, so that stepless spindle speeds ranging from 40 to 400 R.P.M. are available. The lower speeds of this drive can be used to advantage for grinding operations. A solenoid-operated clutch

with push-button control provides means for obtaining a free turning spindle to facilitate truing up or setting the work. The lathe can be quickly put in operation by simply connecting it with the electric power line. Current for the 32-volt machine light or current of any other voltage desired can be taken from the main circuit through a transformer.

The top drawer to the right is fitted for holding collets, and the bottom drawer, which is 9 1/2 inches deep, provides storage space for the faceplate, three- and four-jaw chucks, drill chucks, etc. Two other drawers provide additional storage space. All the drawers are fitted with locks. The base is of 1/4-inch steel construction, and has a laminated hard maple wood top. The motor is completely enclosed and requires no additional guards. The lathe, itself, is a standard Elgin precision bench type with a 1-inch collet capacity, 9-inch swing, and has a maximum capacity between centers of 17 inches. The 3/4- to 3/8-H.P. two-speed motor is equipped with ball bearings. \_\_\_\_\_79

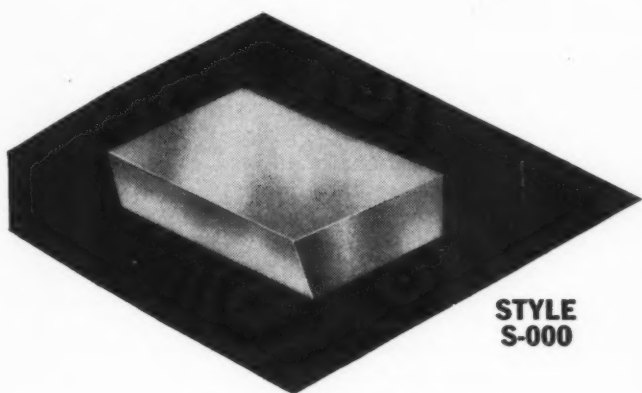
### Carbide-Tipped Cutters for Tool-Holders

Armstrong Brothers Tool Co., 313 N. Francisco Ave., Chicago 12, Ill., has announced the extension of its line of carbide-tool holders



Variable-speed Drive Brought out by the Ohio Gear Co.

*New*  
**KENNAMETAL**  
*"Universal"*  
**BLANKS**



STYLE  
S-000

**FACILITATE  
 TOOL MAKING**  
*and Keep Stocks Down!*

These new Kennametal "Universal" tool blanks are literally "jacks-of-all-trades." Rectangular in shape, with 12° clearance angle formed on one long edge, they can be used to make many different types of tools, simply by setting them into open-end recesses, as illustrated. They are available in all recognized standard sizes, many of which are stocked in several grades.

Their use reduces inventory investment, and simplifies stock room problems. And, above all, they make it easier for you to employ on a widespread, yet economical scale, the advantages of Kennametal—its ability to cut metal, including steel up to 550 Brinell hardness, accurately, at greatly increased speed, with amazing tool life.

*Catalog particulars, and prices,  
 are yours for the asking.*



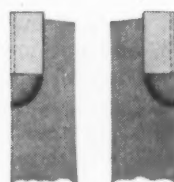
KENNAMETAL Inc., LATROBE, PA.

**ONE STYLE TOOL BLANK**

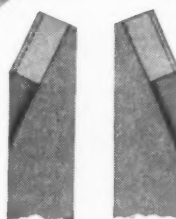


**FOR ALL THESE JOBS . . .**

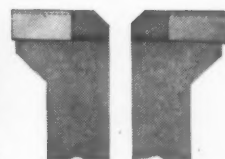
**STRAIGHT  
 TURNING TOOLS**



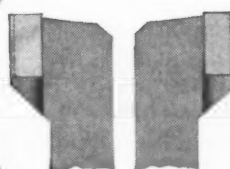
**TURNING TOOLS**



**OFFSET TOOLS**



**OFFSET  
 TURNING TOOLS**



**FACING TOOLS**



**SQUARE NOSE  
 TOOLS**



and "Armide" carbide-tipped cutters to include carbide-tipped cutters with straight, right-hand offset, or left-hand offset shanks in seven sizes. The Armide cutters come tipped with carbides of two grades—Armide Red for machining steel, and Armide Gray for machining cast iron, brass, bronze, aluminum, and non-metallic materials. All sizes of Armide cutters can be furnished ground to four standard shapes, and in two weights—standard and heavy duty.

The standard carbide-tipped tools, which have been designed for general use in tool-rooms, machine shops, and maintenance departments, will be available through industrial supply houses, either singly or in matched tool-holder and cutter sets. The sets will be supplied in fitted steel cases. \_\_\_\_\_ 80

### Scherr "Magni-Ray" Unit

The George Scherr Co., 199 Lafayette St., New York 12, N. Y., has just announced, as the latest addition to the line of "Magni-Ray" products, an illuminated magnifier designed to simplify and speed up visual inspection operations on small precision parts. The



"Magni-Ray" Inspecting Unit



Cylindrical Grinder Brought out by the Norton Co. for Handling Small Precision Work

equipment is also adapted for locating cracks, imperfections, and blow-holes in large castings. The lens, which is 5 inches in diameter, gives a clear, undistorted view of the object inspected. The housing is fastened to a 16-inch upright rod extending from the base, and has a universal clamping device, which permits swiveling in two directions. Light from two 4-inch long 25-watt tubular bulbs is reflected directly upon the work. \_\_\_\_\_ 81

### "Lo-Hed" Electric Hoist

The American Engineering Co., Philadelphia 25, Pa., has recently added a 1/4-ton electric hoist to its line of "Lo-Hed" hoists. This new hoist has a number of unusual features for a hoist of its capacity. For example, a heavy-duty, 3/4-H.P. hoist and crane type motor with high starting torque provides the driving power. Gearing is of the heavy-duty spur type. The lowering brake is automatic.

The electric brake, built integral with the motor, has full-load torque capacity. The heavy-duty push-button control pendent is reinforced by a steel pull cable. The chassis is of heavy-gage pressed steel. The bolt suspension type hoist weighs 195 pounds, and the plain trolley type 225 pounds. The trolley is especially designed to withstand the initial shock of electric hoisting and lowering. \_\_\_\_\_ 82

### Norton Cylindrical Grinder

The Norton Co., Worcester 6, Mass., has announced the addition of a 4-inch Type C cylindrical grinder to its line of grinding and lapping machines. The new grinder, made in 12- and 18-inch lengths, is designed for short-length, small-diameter work. It is intended for high-production precision work, and is so arranged that adjustments can be made quickly and easily.

This grinder is particularly adapted for use in the airplane, automotive, and instrument parts industries. It has hydraulic table traverse,

automatic in-feed of the wheel at each table reversal, and adjustable dwell at each end of the table traverse. It is available in plain or semi-automatic types.

When a semi-automatic machine is desired, continuous wheel feed can be furnished. Work speeds range from 100 to 1000 R.P.M. Grinding wheels 16 inches in diameter and up to 3 inches wide are available for this machine. The wheel-spindle has automatic lubrication. Automatic coolant controls are also provided. The maximum floor space occupied by the longer of the two machines is approximately 75 by 55 inches. \_\_\_\_\_ 83



"Lo-Hed" Electric Hoist

rical

Wor-  
s an-  
on of  
cylind-  
s line  
pping  
new  
12-  
s, is  
ort-  
meter  
d for  
reci-  
is so  
just-  
ade

par-  
or use  
tomom-  
ent  
t has  
verse,  
eel at  
stable  
trav-  
in or

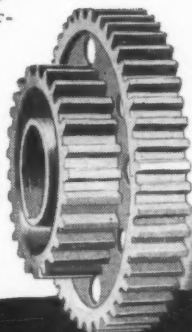
chine  
feed  
peeds  
P.M.  
diam-  
e are  
The  
lubri-  
ntrols  
imum  
onger  
proxi-  
83

ment  
ge 200



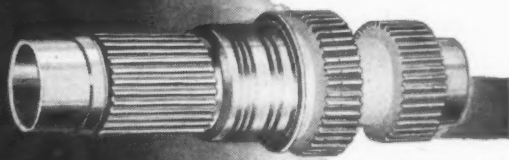
Diameter: 17 1/2 Feet

*Gears as large as this giant or as small as you wish—produced individually or on a production basis.*



Diameter: 5 Inches

*"Aircraft Quality" Gears can give you higher speeds, lighter weight, less noise and greater efficiency.*



Length: 10 1/2 Inches

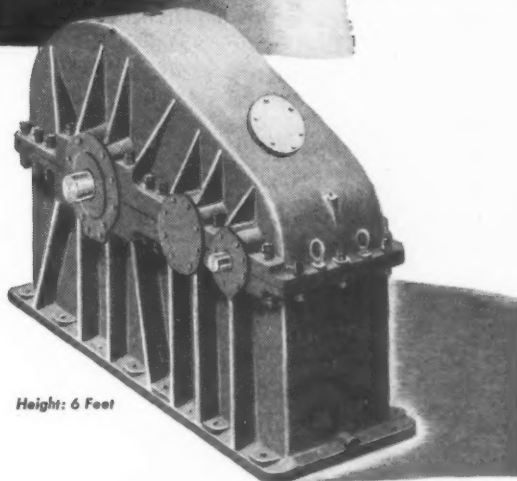
**FOR BETTER POWER TRANSMISSION  
CALL FOOTE BROS.**

You may require a giant spur gear to turn a cement kiln. Your production may demand gears of aircraft quality produced by the thousands. You may operate a paper mill—a steel mill—a chemical plant—where your needs for speed reducers vary from mid-gets, so small you can lift them with one hand, to giants weighing tons. Or, perhaps, you build aircraft engines where advances in gear engineering and newly developed production techniques have made possible the mass manufacture of gears that closely approach engineering perfection.

No matter what application for power transmission equipment you may have—Foote Bros. can aid you.

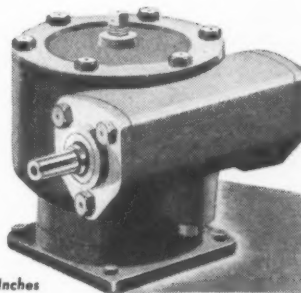
Why not let the years of experience—the vast production facilities—the manufacturing "know-how" of one of America's largest and oldest makers of gears help you solve your power transmission problem?

FOOTE BROS. GEAR AND MACHINE CORPORATION  
Dept. P, 5225 S. Western Boulevard • Chicago 9, Illinois

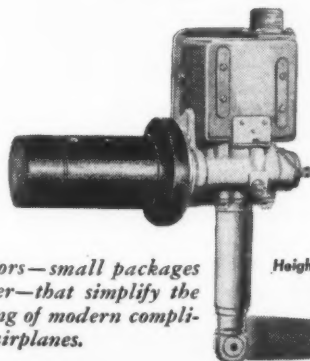


Height: 6 Feet

*Speed reducers in a wide range of sizes and gear ratios to meet practically every industrial need.*



Height: 5 Inches



*Actuators—small packages of power—that simplify the handling of modern complicated airplanes.*

Height: 13 Inches



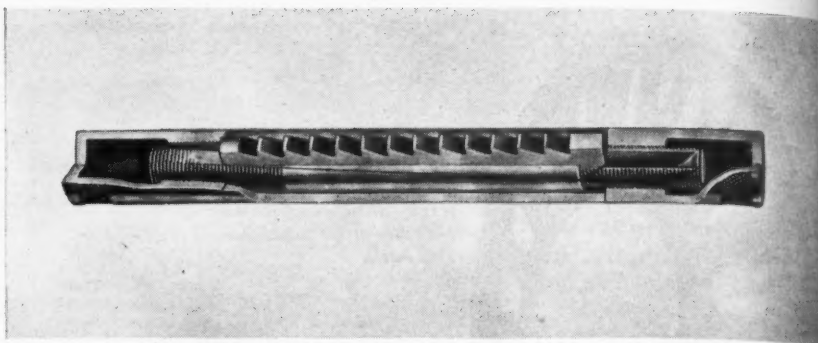
**FOOTE BROS.**

*Better Power Transmission Through Better Gears*

## Glenny Adjustable Expansion Push-Broach

The East Shore Machine Products Co., 835 E. 140th St., Cleveland 10, Ohio, has placed on the market an adjustable expansion push type broach, known as the "Glenny," which is available in a range of sizes for cutting keyways in holes from 3/8 inch to 1 1/2 inches in diameter. It can also be made to order for broaching keyways in holes ranging in diameter from 1 5/8 to 2 1/2 inches. This broach consists of five parts—a sleeve which guides the broach in its passage through the hole in which the keyway is to be cut; a body which acts as a rigid support for the blade and provides means for accurate blade adjustment; a broach blade made from high-speed tool steel, ground to an accuracy of plus or minus 0.0005 inch; an adjusting nut with fine screw adjustment, which allows the blade to be raised in the taper of the body to increase the depth of cut; and a pilot nut which locates the broach in the proper position for cutting and also serves to lock the blade securely in place.

The broach can be used on an arbor press, lathe, turret of a screw machine, or on other standard equipment that provides means



Glenny Adjustable Push-broach for Cutting Keyways

for pushing it through the hole in which the keyway is to be cut. It will broach slots up to 5 inches in length and 5/8 inch in width, and can be used to release more ex-

pensive types of equipment for other work. The cutter blades are designed to allow numerous regrinds before replacements become necessary. 84

## Internal Gear Checking Machine

The National Broach & Machine Co., 5600 St. Jean, Detroit 13, Mich., has developed an internal gear checker designated the S.I.G. for checking the tooth spacing, eccentricity, pitch diameter, and root diameter of spur or helical gears from 3 to 64 diametral pitch and from 2 to 18 inches pitch diameter. With the auxiliary head, the parallelism of spur gear teeth can also be easily and accurately checked.

The principal elements of the machine consist of a rigid base having a finished top, a work-spindle mounted on precision anti-friction bearings, an adjustable counterweighted column, and a checking head, carried on the end of an over-arm which permits adjustment axially to and from the work-spindle axis as required to accommodate gears of different diameters or designs.



Fig. 1. Machine for Checking Internal Spur and Helical Gears

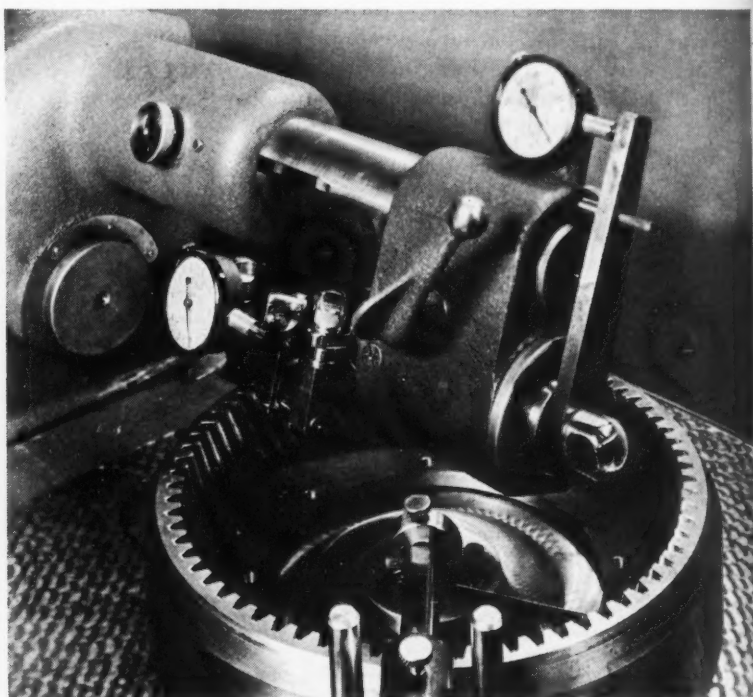


Fig. 2. Close-up View of Checking Head of Machine Shown in Fig. 1 Set up for Checking Gear

GEARS FOR AIR POWER

12 MORE PER TOOL GRIND



## **SUNICUT** improves finish of gears... tool life increased from 8 to 20 pieces

The outstanding progress of metal working in the aviation industry may be credited to the ready adoption of new and better methods. This is especially true in cutting lubricants!

**Short Tool Life** and inferior finish were slowing production in a plant machining airplane gears. Several well-known cutting lubricants were used up to seven months ago. Then a Sun Cutting Oil Engineer stepped in, studied operating conditions and recommended Sunicut.

**Output increased 150%** per tool grind. With Sunicut they increased tool life

from a previous average of 8 pieces per tool grind to 20 pieces. Results... longer tool life... improved quality of finish... less time lost for tool resetting.

**Experiences of operators** of machine tools prove the production value of Sunicut — developed to make tools hold their edges longer, cut faster and produce better finishes. Put this transparent, free-flowing, sulphurized cutting lubricant to work in your shop. Write for details to...

**SUN OIL COMPANY • Philadelphia 3, Pa.**  
*Sponsors of the Sunoco News Voice of the Air—Lowell Thomas*



# **SUN INDUSTRIAL PRODUCTS**

OILS FOR AMERICAN INDUSTRY

The checking-head spindle, at right angles to the work-spindle, is advanced toward the work-gear teeth by means of adjustable spring pressure. The spindle is retracted by means of a hand-lever at the front of the checking head. At the forward end of the checking-head spindle there is a rigid ball-pointed contact finger and a movable pivot finger, the latter actuating the spindle of an indicator on which errors in tooth spacing or indexing can be read to 0.0001 inch.

The rear end of the checking-head spindle carries an arm which contacts the spindle of an indicator reading to 0.0005 inch. The indicator is located on top of the checking head, and registers the axial movement of the checking-head spindle when measuring eccentricity, errors in pitch diameter, and root diameter. An adjustable gear-tooth locator mounted on the table serves to position the work-gear with reference to the ball-point contact finger. \_\_\_\_\_ 85

## Clark Precision Boring-Bar

The Robert H. Clark Co., 9330 Santa Monica Blvd., Beverly Hills, Calif., has brought out a precision lever-lock boring-bar designed to hold separate tool bits for boring small-diameter holes. This boring-bar is intended as a companion tool to the Clark adjustable tool-holder, and is available in sets of four sizes ranging from 3/16 inch by 5 inches to 1/2 inch by 8 inches.

One precision-ground high-speed threading bit and one boring bit are provided ready for use with each boring-bar. The lever-lock arrangement serves to hold the tool bit at a right angle on one end of



Clark Lever-lock Boring-bar

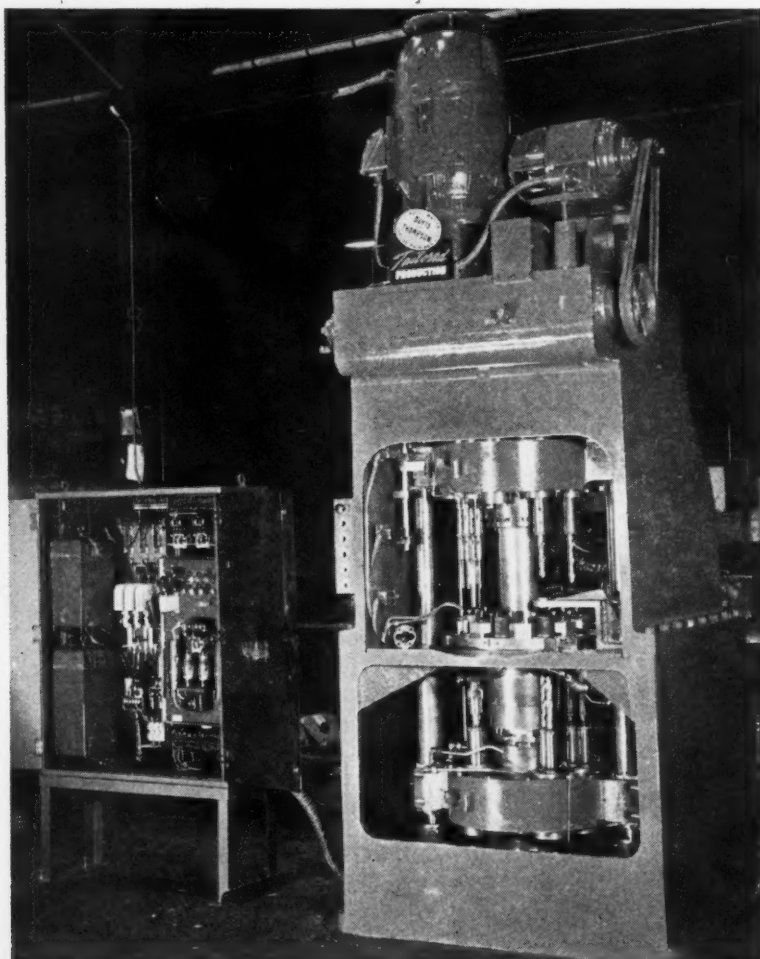
the bar and at an angle of 15 degrees on the opposite end. Replacement cutters can be readily made from round carbon or high-speed steel drill rod. \_\_\_\_\_ 86

## Eight-Station Indexing Machine Equipped for Drilling Universal Joint Body

A vertical eight-station indexing machine has been developed by the Davis & Thompson Co., 6411 W. Burnham St., Milwaukee 14, Wis.,

to perform a series of operations on a universal joint body without removing the work from the machine. Power for driving the spindles is supplied by a 25-H.P. motor. The feed and rapid traverse movements are driven by a 1 1/2-H.P. Thy-mo-trol motor in conjunction with a two-speed electrically operated gear-box, built into the top of the machine. Spindle heads are driven through a spline shaft and fed by two screws equipped with adjustable nuts. The feed can be varied from 1/2 inch to 7 inches per minute. Rapid traverse is at the rate of 100 inches per minute.

The sequence of operations performed at successive stations is as follows: First station—Two 63/64-inch holes are drilled 1 7/8 inches deep from the bottom and one 7/8-inch hole 1 1/2 inches deep from the top, the drills being guided by drill bushings. Second station—Two 1-inch holes are reamed from the bottom through drill bushings and the 7/8-inch hole is drilled from the top. Third station—The under-cut for grinding is made by a special grooving tool from the bottom. No work is performed from the top at this station. Fourth station—A chamfer is cut by two spindles from the bottom. The center hole is enlarged by a special core drill to a depth of 1 1/2 inches from the top. Fifth station—The mounting holes are drilled from the bottom. The center hole is drilled through and a 2-inch taper hole is produced by a special core drill from the top. Sixth sta-



Davis & Thompson Indexing Machine Developed for Drilling Universal Joint Bodies

15 de-  
eplace-  
made  
-speed  
86

rations  
without  
ne ma-  
e spin-  
motor.  
move-  
2-H.P.  
unction  
oper-  
top of  
ls are  
ft and  
l with  
can be  
inches  
is at  
minute.  
as per-  
s is as  
63/64-  
inches  
ne 7/8-  
o from  
ded by  
ation—  
l from  
ishings  
drilled  
n—The  
ade by  
om the  
formed  
station.  
is cut  
bottom.  
l by a  
of 1 1/2  
station  
drilled  
er hole  
2-inch  
special  
th sta-



# MACHINERY'S DATA SHEETS 529 and 530

## ELECTRONIC CONTROL "TROUBLE-SHOOTING" CHART—3

General Items for All Types of Electronic Control

Trouble	Cause	Remedy
<p><b>Failure of tubes to operate when starting equipment</b></p> <p><i>WARNING—Tube filament or heater circuits may be at high voltage above ground. Use extreme care in making measurements and adjustments.</i></p>	<p>Interlocks or protective control devices not operating properly</p> <p>Cathode protective timer has not completed its timing cycle</p> <p>No voltage at control panel terminals</p> <p>Incorrect power</p> <p>Missing connection</p> <p>Tubes will not heat up</p> <p>Tubes may have been damaged internally through shipment</p>	<p>Check contacts to see that they close and that they are clean.</p> <p>Wait until timing cycle is completed before attempting to operate equipment.</p> <p>Check external connections to be sure that they are correct.</p> <p>Check fuses.</p> <p>Check panel connections to be sure they are right.</p> <p>Check the terminal voltage to make sure it corresponds with nameplate rating.</p> <p>Recheck the circuit with wiring diagram.</p> <p>Check with wiring diagram to make sure tubes are in the right places. The thyatron tube will be warm when cathode is heated. Do not touch metal power tubes while power is on the panel.</p> <p>Replace damaged tube.</p>
<p><b>Overheated transformer or reactor</b></p>	<p>Overload</p> <p>Defective unit</p>	<p>Check cause of overload and remove.</p> <p>Warning is usually given by the odor of excessive heating, melting of the sealing compound, smoking or charring of the insulating paper. Replace transformer.</p>

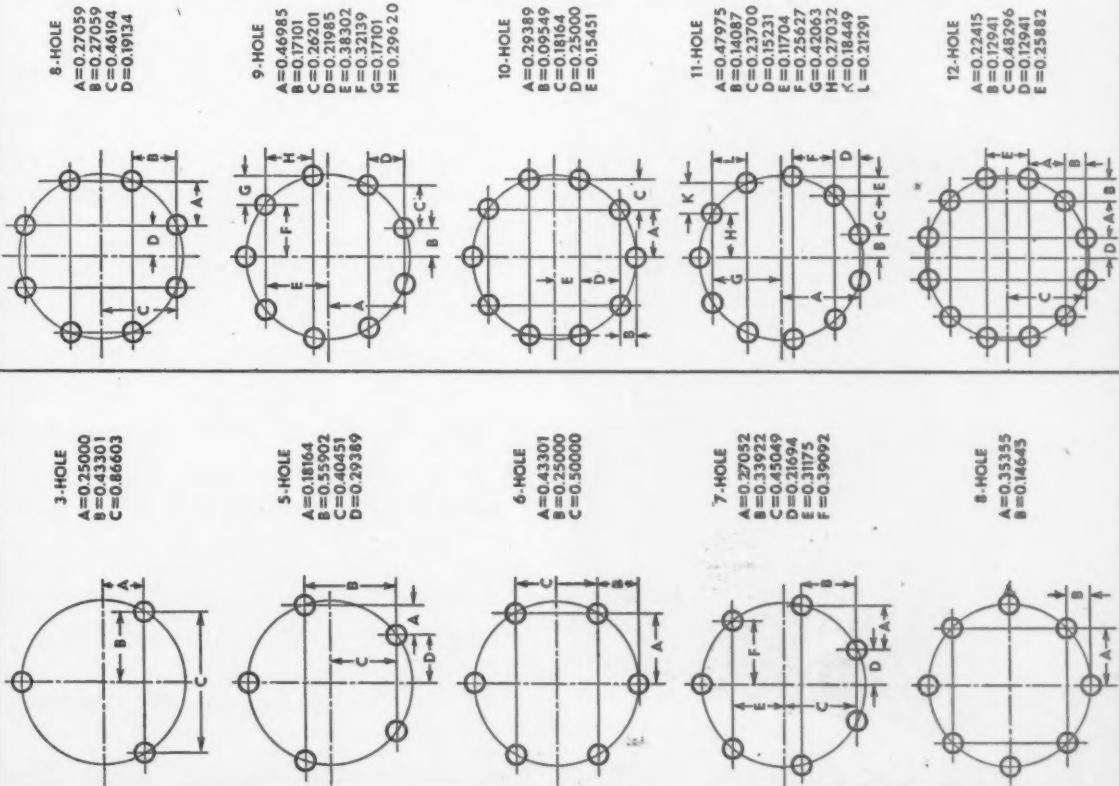
MACHINERY'S Data Sheet No. 529, January, 1945

Compiled by the General Electric Co.  
Schenectady, N. Y.

## LAY-OUT CONSTANTS FOR HOLE CENTERS OF BOLT CIRCLES

For Use with Jig Boring Machines

Multiply values shown by diameter of pitch circle.

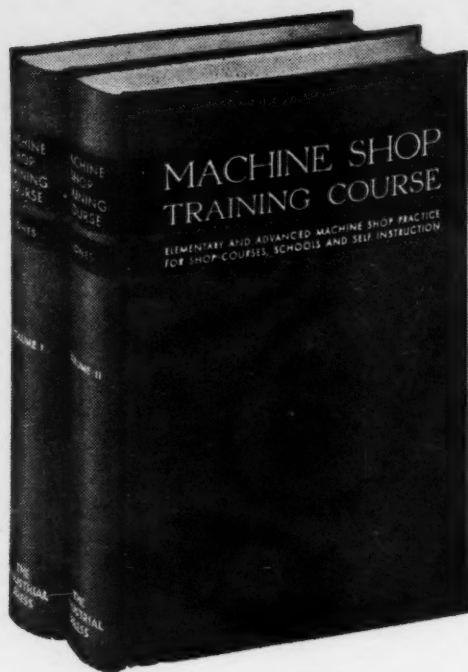


MACHINERY'S Data Sheet No. 530, January, 1945

Compiled by Paul Glaesme  
Goshen, Ind.

# Machine Shop Training Course

## WITH BLUEPRINT READING CHARTS



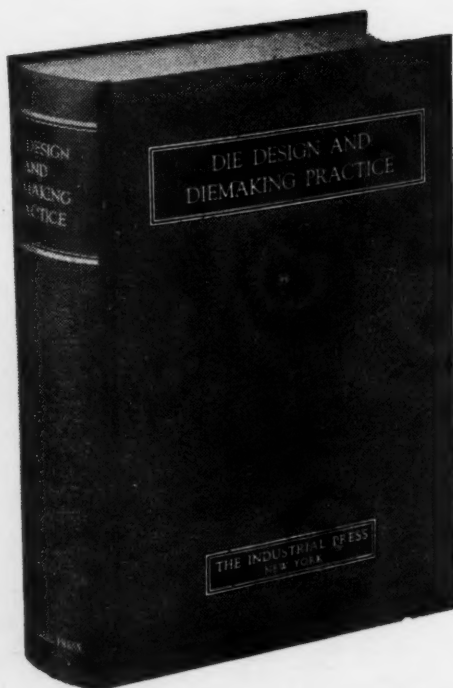
**Price \$6 Set—Payable \$2  
with Order, \$2 Monthly**

This standard treatise on machine shop practice in two volumes is for the shop man who wants to supplement his own experience with a broad fund of practical knowledge; for use as a textbook and guide in shop training courses; for technical or trade schools; for designers who want the fundamentals of machine shop practice; for mechanical engineering students.

The MACHINE SHOP TRAINING COURSE contains over 1100 pages of questions and answers. These questions deal with the elements of machine shop practice and other subjects closely allied to the work of the shop. The answers are packed with useful facts, shop rules, typical shop problems and their solutions. 524 drawings and photographs illustrate all kinds of machining operations, cutting tools, gages, etc.

**THE INDUSTRIAL PRESS, 148 Lafayette Street, New York 13, N. Y.**

# Die Design and Diemaking Practice



If you design, make or use dies for blanking, forming or drawing sheet-metal parts, here is a veritable die designer's and diemaker's bible. This die book presents not only descriptions and drawings of a tremendous variety of dies, but a vast amount of data representing a lot of boiled down and costly die experience. Dies of the same general classes are grouped together in chapters. The drawing dies have been placed into chapters according to the general shapes of the parts produced, to facilitate finding the type of die for producing a given shape. Price \$6—payable if desired \$2 with order and \$2 monthly for two months.

**956 pages, 590 illustrations**

**THE INDUSTRIAL PRESS, 148 Lafayette Street, New York 13, N. Y.**





tion  
a f  
a  
Sev  
are  
1 1  
fro  
Lo  
by  
the  
de  
not  
op  
rev  
ge  
a  
pi  
ba  
ra  
co  
us

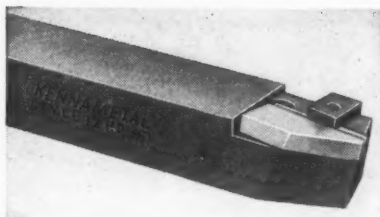
is  
ha  
K  
m  
in  
in  
ov

tion—The center hole is reamed by a form reamer from the top, using a guide bushing and pilot bar. Seventh station—Mounting holes are reamed from the top and the 1 1/2-inch center hole is chamfered from the bottom. Eighth station—Loading.

The cycle of operations is begun by pressing the starting button, the machine being locked and indexed by hand. The machine will not feed unless the drive motor is operating. Feed can be stopped and reversed by pressing the emergency return button. Production at a 2-inch per minute feed is 60 pieces per hour. The heads are balanced by means of a unique arrangement, one head acting as a counterweight for the other by the use of a spring-loaded sheave.....87

### Heavy-Duty Tools with Clamped-In Kennametal Tips

Kennametal, Inc., Latrobe, Pa., is now producing a line of tools having clamped-in, advanceable Kennametal tips for heavy-duty machining operations on steel castings, forgings, bar stock, and cast iron. The heavy-duty tips, while overhanging the tool shanks by



Kennametal Clamped-in Tip Heavy-duty Tool

about 1/16 inch, have ample strength to withstand heavy feeds and deep cuts.

The special type of Kennametal tip used in these tools has a clamp-

ing shelf along the top on the side opposite the cutting edge, and is diamond ground on the under side. When dull, the tip is advanced and resharpened. It can be reground many times, since it is advanced to the front and side in the oblique recess, until the major part of it has been utilized.

The tips are available in grades KM and K3H for general steel cutting, grade K2S for machining steel castings where scale is encountered, and grade K6 for machining cast irons. The tools are made in several styles in the larger sizes, which have shanks more than 1 inch in width. ....88

### Watson-Stillman 200-Ton Molding Press and 500-Ton Flanging Press

A 200-ton hydraulic molding press of the upward moving ram type, which has a floating center platen, special transfer molding attachments, and hydraulic bottom strippers, has just been added to the line made by the Watson-Stillman Co., Roselle, N. J. This machine, shown in Fig. 1, can be arranged for accumulator operation or it can be furnished with a self-contained power unit. It has an operating pressure of 2500 pounds per square inch. The platen area

is 30 by 24 1/2 inches. The center platen is adjustable from 11 to 32 inches, and the top platen is adjustable from 3 to 4 inches, daylight opening.

The bottom strippers are adjustable for a stroke of from 1 to 3 inches. The stroke of the main ram is 24 inches, and the diameter 15 inches. The top transfer cylinder has a capacity of 20 tons, the pull-back cylinders 24 tons, and the bottom stripper cylinders 12 tons. This press occupies a floor space of 3 by 4 feet. The over-all height is 13 feet 3 inches, and the weight approximately 12,800 pounds.

The 500-ton flanging or "jog-gling" press of the gap type shown in Fig. 2 is another recently announced development of the Watson-Stillman Co. This press has a frame of welded steel construction which is designed to handle heavy plate work. The dual delivery pump of this press is driven by a 20-H.P. motor, and has a capacity of 103 gallons per minute at low pressure and, 14.7 gallons per minute at high pressure. This arrangement provides a maximum operating pressure of 2900 pounds per square inch.

The vertical or main ram has a capacity of 500 tons and a stroke of 12 inches. The throat depth is 28 inches, the size of the moving platen 36 by 36 inches, and the size of the bed 66 by 55 inches. The horizontal ram has a capacity of 250 tons, a stroke of 7 inches, and a clamping platen of 24 by 24 inches.

The vertical ram has an advan-

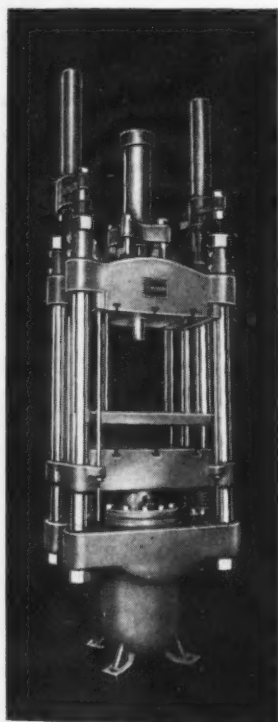


Fig. 1. Watson-Stillman Hydraulic Molding Press

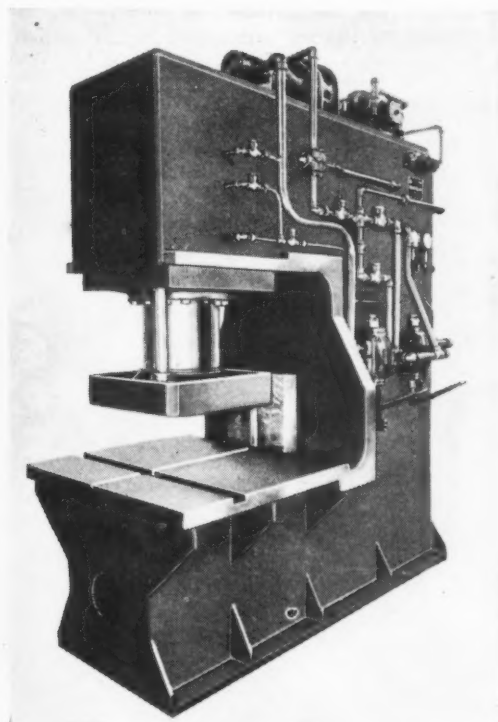


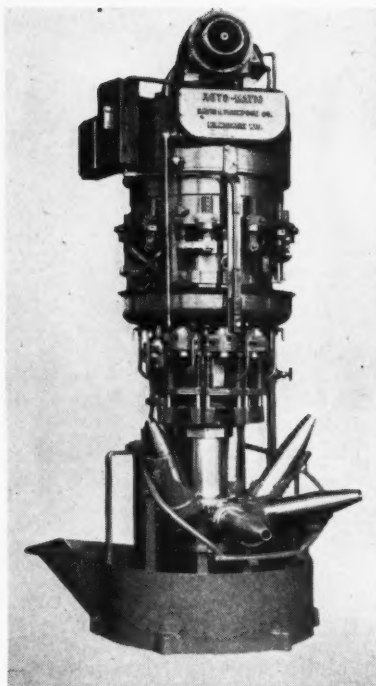
Fig. 2. Watson-Stillman Gap Type Flanging Press of 500-ton Capacity

cing speed of 68.5 inches per minute, a pressing speed of 9.8 inches per minute, and a return speed of 106 inches per minute. The horizontal ram has an advance speed of 135 inches per minute, a pressing speed of 19 inches per minute, and a return speed of 150 inches per minute. The press is 14 feet 6 1/2 inches high, requires a floor space of 5 feet 6 inches by 10 feet 10 inches and weighs approximately 80,000 pounds. \_\_\_\_\_ 89

### "Roto-Matic" Vertical Shell-Nose Reaming Machine

The Davis & Thompson Co., 6411 W. Burnham St., Milwaukee 14, Wis., has recently adapted an eight-spindle "Roto-Matic" driller for the reaming of the nose end of 155-millimeter high-explosive shells. Rotation of the machine causes the outside cam to carry the shell into the clamping position. At a predetermined point the cutter-spindles are automatically fed in, and at the same time the clamping mechanisms are actuated.

On completing the reaming operation, the spindle is automatically withdrawn and the clamping mechanism released. The machine operates continuously and is non-indexing. Two men load and unload the shell cases while the ma-



Davis & Thompson Shell-nose Reaming Machine

chine is in operation. The production is 300 shells per hour. \_\_\_\_\_ 90

### Logan Quick-Change Gear Turret Lathe

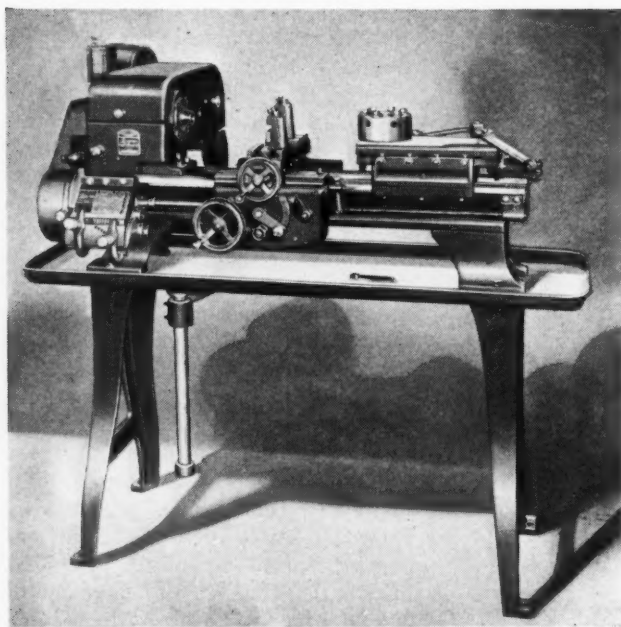
A quick-change gear turret lathe designed for simplicity of operation and to insure sustained accu-

racy at high output speeds has been brought out by the Logan Engineering Co., 4901 W. Lawrence Ave., Chicago 30, Ill., for use in diversified industrial fields. This lathe, designated No. 840, will handle bar stock in sizes up to and including 5/8 inch in diameter. The spindle mounting is of the precision preloaded ball bearing type. Adjustable gibbs compensate for wear on the turret and cross-slide, and self-lubricating bronze bearings serve to protect vital points in the lathe.

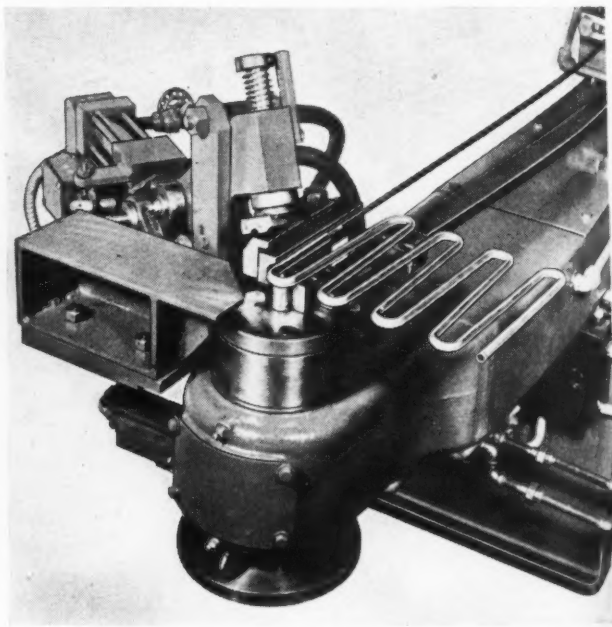
An interesting feature of this lathe is the automatic apron, which is operated from a spline in the lead-screw acting through a worm-driven friction clutch to obtain both longitudinal and cross feeds. There is an additional longitudinal drive for cutting threads, which is driven through half-nuts on the lead-screw. A safety device is provided which makes it impossible to engage both drives simultaneously. The worm and gear operate in an oil bath. \_\_\_\_\_ 91

### Pines Automatic Bender

The Pines Engineering Co., 600 Prairie, Aurora, Ill., has just brought out a new small-size Series 100 high-speed fully automatic bender designed to handle tubing up to 1 inch outside diameter. This machine was developed especially



Quick-change Gear Turret Lathe Brought out by Logan Engineering Co.



Small-size Automatic Tubing Bender Built by Pines Engineering Co.

*New Approach*

*IS Revolutionizing* **GRINDING**

**PRACTICE AND RESULTS**

**QUAKER**

# MICROGRIND P R O C E S S

applied to the grinding and honing operations in your plant, makes possible these specific benefits:

- Elimination of cracks on ground surfaces.
- Elimination of burns and distortion due to grinding.
- Much finer truly ground finishes.
- Greatly increased number of pieces obtained for each wheel dressing. (usually tripled)
- Immediate wheel life increase. (often 200% or 300%)
- Power consumption cut approximately 50%.
- Great increase in grinding production and virtual elimination of rejects.

A Quaker Process Engineer will welcome the opportunity to provide details and prove all the above claims at our expense!

**QUAKER**

**CHEMICAL PRODUCTS CORP.**



Other Plants in CHICAGO and DETROIT

Warehouse Stocks in Principal Industrial Centers

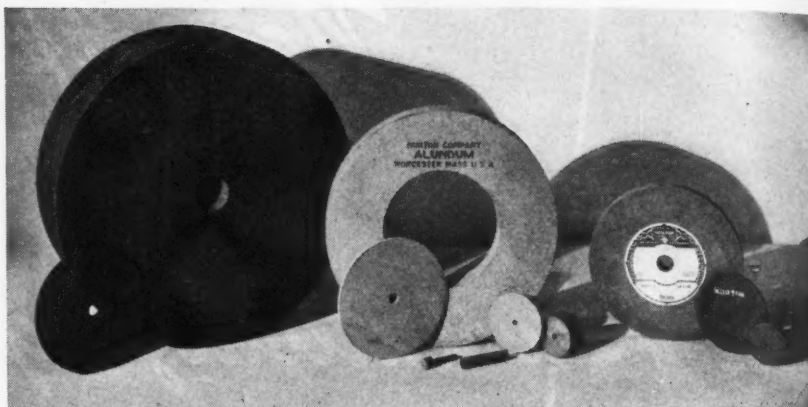
*A Progressive Organization of  
Research and Process Engineers  
and Manufacturing Chemists*

Name \_\_\_\_\_ Position \_\_\_\_\_

...PLEASE PRINT COMPANY NAME AND ADDRESS IN MARGIN BELOW...

for the high-production bending of small-diameter tubing such as is used in the production of heating and refrigerating equipment, tubular furniture, and work of a similar nature.

When equipped with a multiple angle selector, this bender will make up to fifty tubular chair frames per hour, with eight bends in each frame. The accompanying illustration shows a special application of this machine for making serpentine coils. The machine is equipped with the Pines booster attachment for automatically advancing the coil for each successive bend. Simply pressing the starting button causes the bender to complete the entire cycle, including automatic ejection and return to the starting position. Up to 600 bends per hour can be made with this machine when used for operations on copper tubing having an outside diameter of 5/8 inch.



"Norflex" Polishing Wheels of Three Types Brought out by Norton Co.

### "Norflex" Polishing Wheels

The Norton Co., Worcester 6, Mass., has announced to the trade a line of solid polishing wheels designated "Norflex." These wheels are available in three types—cork resinoid, fiber resinoid, and resilient rubber. These three types make it possible to meet the special requirements of a wide range of deburring, finishing, and polishing operations which until recently were performed by slow and labori-

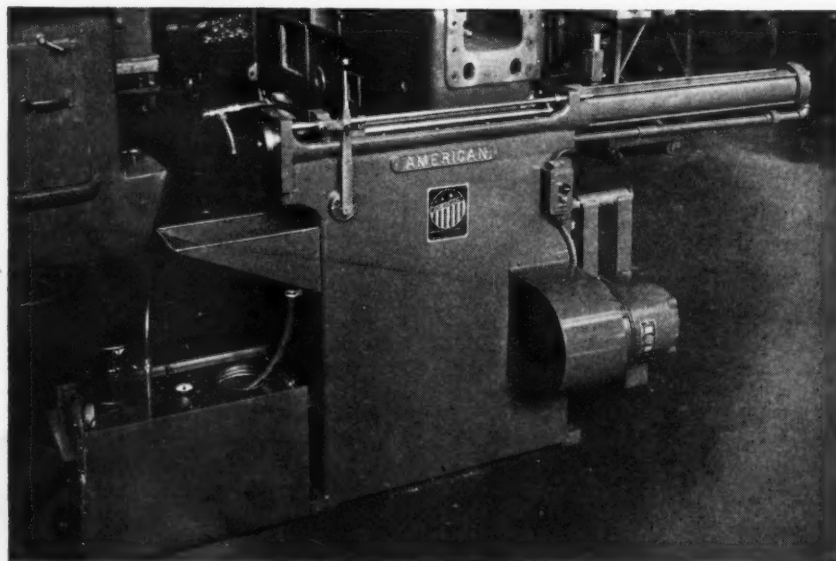
The Series 100 automatic benders are made in five sizes, the largest size being capable of handling pipe and tubing up to 4 inches in diameter. Bar stock, angles, channels, and molding can also be handled on these machines. \_\_\_\_\_92

ous hand filing, scraping, and sanding.

All three types of Norflex abrasive wheels are similar in that they

possess a relatively soft and flexible bond that imparts a cushion like action, insuring a smooth, uniform finish. They differ from the conventional grinding wheels in that they are designed to rapidly and economically remove only a relatively small amount of material, such as a burr or sharp edge, or to polish a surface that has already been finished to size. These three types of wheels differ from each other with respect to the kind of flexible bond that supports the abrasive grain. \_\_\_\_\_93

### Hydraulic Broaching Machine for Small Work



Small Size Broaching Machine Brought out by the American Broach & Machine Co.

A horizontal hydraulic broaching machine designed to meet the demand for a fast, accurate machine of small size has been

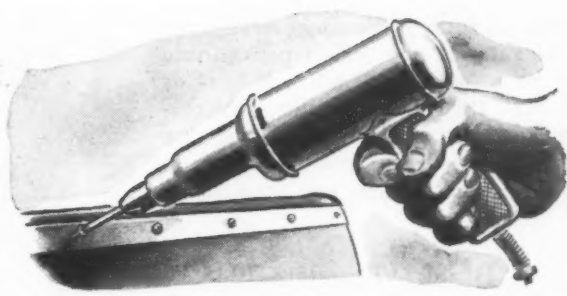
brought out by the American Broach & Machine Co., Ann Arbor, Mich. This machine has a maximum capacity of 2200 pounds, and can be used for either pull- or push-broaching and for light push assembly work. It has a maximum stroke of 20 inches, and will complete a full 20-inch cutting stroke in 4 1/2 seconds. Broaches up to 23 1/2 inches in length can be used. The faceplate is 7 1/2 inches wide by 6 inches high. The hole through the faceplate is 2 inches in diameter. Two types of pull-heads are available for connecting various styles of broaches.

The machine is controlled by a hand-lever which operates a four-way valve. The pressure at either end of the hydraulic cylinder can be easily read on the gage. The stroke can be adjusted to any desired length by means of a stop-collar, and provision is made for reducing the broaching speed in either direction as much as 33 1/3 per cent. The approximate speeds range from 18 to 24 feet per min-



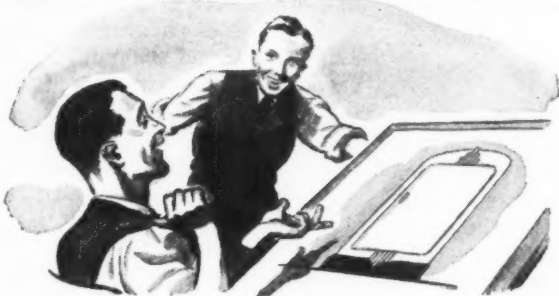
### IT'S A TIME SAVER!

So long as his plant stuck to slotted screws, this assembly man had to stick to hand driving. Too much danger of power drivers skidding and gouging the carriage's finished surface—making costly refinishing necessary.



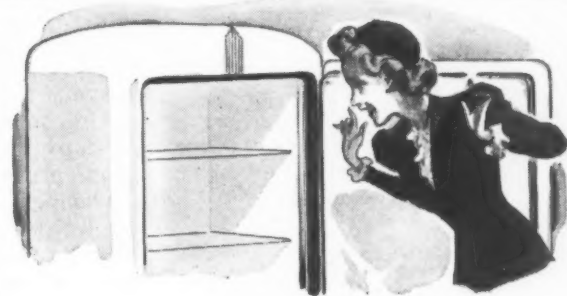
### IT'S A MONEY SAVER!

A shift to Phillips Screws permitted a switch to power driving. Thanks to the Phillips Recess, driver skids stopped. Result: a fast, money-saving process instead of a slow, high-cost hand operation!



### IT'S A PROBLEM SOLVER!

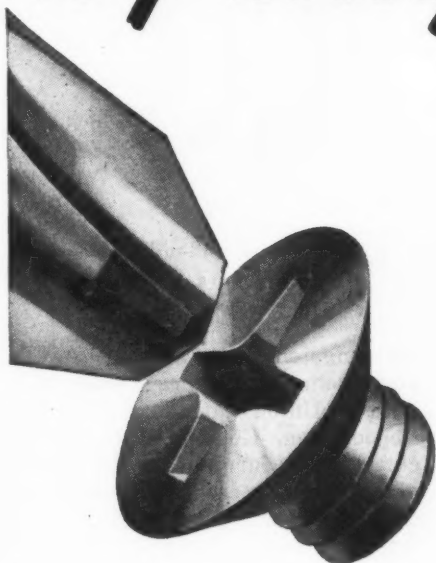
Management and workers aren't the only ones who benefit from Phillips Screws. Design Engineers find there's no easier way to plan extra fastening strength and rigidity into a modern streamlined product—and to lower costs at the same time!



### IT'S A SALES BUILDER!

To salesmen, too, use of Phillips Screws pays dividends: in a stronger, smarter product... that has no burred screw heads to disfigure surfaces and snag clothing. Ornamentally as well as functionally, this recess is engineered to **SELL** your product!

# It's Phillips <sup>AAA</sup> the engineered recess!



In the Phillips Recess, mechanical principles are so correctly applied that every angle, plane, and dimension contributes fully to screw-driving efficiency.

... It's the exact pitch of the angles that eliminates driver skids.

... It's the engineered design of the 16 planes that makes it easy to apply full turning power—without reaming.

... It's the "just-right" depth of recess that enables Phillips Screw Heads to take heaviest driving pressures.

With such precise engineering, is it any wonder that Phillips Screws speed driving as much as 50%—cut costs correspondingly?

To give workers a chance to do their best, give them faster, easier-driving Phillips Recessed Head Screws. Plan Phillips Screws into your product now.

## PHILLIPS <sup>Recessed Head</sup> SCREWS

WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOLTS

Made in all sizes, types and head styles

**24 SOURCES**

American Screw Co., Providence, R. I.  
Atlantic Screw Works, Hartford, Conn.  
The Bristol Co., Waterbury, Conn.  
Central Screw Co., Chicago, Ill.  
Chandler Products Corp., Cleveland, Ohio  
Continental Screw Co., New Bedford, Mass.  
The Corbin Screw Corp., New Britain, Conn.  
General Screw Mfg. Co., Chicago, Ill.

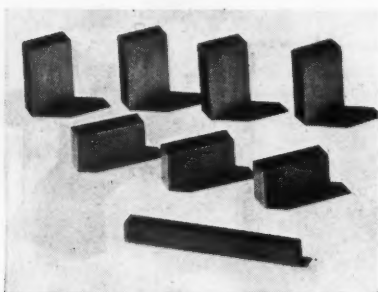
The H. M. Harper Co., Chicago, Ill.  
International Screw Co., Detroit, Mich.  
The Lamson & Sessions Co., Cleveland, Ohio  
Manufacturers Screw Products, Chicago, Ill.  
Milford Rivet and Machine Co., Milford, Conn.  
The National Screw & Mfg. Co., Cleveland, Ohio  
New England Screw Co., Keene, N. H.  
Parker-Kalon Corp., New York, N. Y.

Pawtucket Screw Co., Pawtucket, R. I.  
Pheoli Manufacturing Co., Chicago, Ill.  
Reading Screw Co., Norristown, Pa.  
Russell Burdall & Ward Bolt & Nut Co., Port Chester, N. Y.  
Scovill Manufacturing Co., Waterville, Conn.  
Shakeproof Inc., Chicago, Ill.  
The Southington Hardware Mfg. Co., Southington, Conn.  
Wolverine Bolt Co., Detroit, Mich.

ute. A pump supplies coolant at the rate of one gallon per minute from a 10-gallon tank. A 3/4- or 1-H.P. 1800-R.P.M. motor is recommended for the drive. The machine requires a floor space of 11 by 30 inches, and weighs 820 pounds. 94

## Black "Hardsteel" Tool Tips

The Black Drill Co., Division of Black Industries, 1400 E. 222nd St., Cleveland 17, Ohio, has recently added to its products a line of tool tips made of "Hardsteel." These tips are designed to be



"Hardsteel" Tool Tips Made by  
Black Drill Co.

brazed to steel shanks, and are made of the same metal used in the "Hardsteel" drills made by this company for drilling hardened steel without previous annealing. They are especially adapted for machining the harder and tougher steels and the abrasive copper and light metal alloys. Standard sizes are available from stock, and special sizes can be supplied for unusual applications. 95

## Duralite Improved Safety Goggles

An improved Duralite safety goggle has just been placed on the market by the American Optical Co., Southbridge, Mass. The newly designed eye-cup of this goggle is considerably larger in area and conforms more closely to the contours of the face than previous models. It provides maximum eye protection, increased ventilation, and greater comfort. The eye-cups are shaped separately to fit the contours of the right and left eye, and fit snugly against the face, so that they protect the eye from ob-



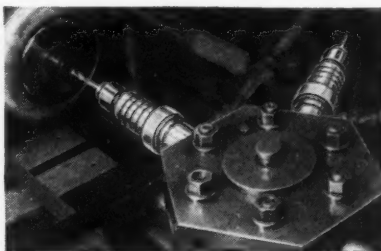
Improved Duralite Safety  
Goggle

jects striking from the side, top, or bottom. They are non-conductors of heat and electricity, and provide a wider angle of vision than the previous models.

Air channels in the edge of the eye-cups and extra side perforations provide better ventilation, producing a natural draft behind the lens which reduces the possibility of fogging. The new 301A Duralite goggle is supplied with either 50-millimeter Super Armorplate lenses in white glass, or 50-millimeter Super Armorplate lenses in Calobar medium, dark, or extra dark shades. 96

## Keller Pneumatic Screw Machine Drills

A new line of air drills designed for use on hand and automatic screw machines has been brought out by the Keller Tool Co., Grand Haven, Mich. These drills can be mounted in the regular tool-holders of automatic or hand screw machines. Compressed air is fed to the drills through a valve arrangement, which opens as the turret moves forward and closes immediately when the turret is backed away from the work.



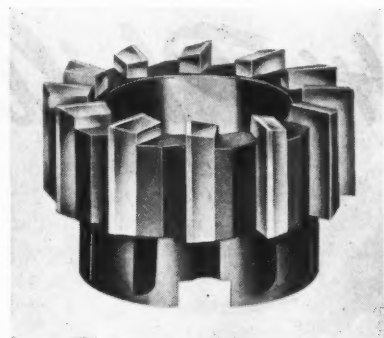
Screw Machine Turret  
Equipped with Keller  
Pneumatic Drills

Two advantages claimed for this method of driving standard twist drills instead of holding them stationary are first, the effective drilling speed can be increased by 1200 to 3500 R.P.M. for drilling small deep holes on the larger type of screw machines having spindle speeds much too slow for satisfactory cutting action; and second, holes drilled by this method will not "run out," as the air drill spindle revolves in a direction opposite to the direction of the work in the screw machine spindle. This results in a true hole and eliminates drill breakage.

These new screw machine drills are available in three sizes and eight models having speeds of 1200, 2800, and 3500 R.P.M. Drill capacities range from 1/32 to 3/8 inch in diameter. All tools are powered by the Keller standard rotary vane type pneumatic motors. 97

## Shell End-Mills with Haynes Stellite Blades

Small standard shell type end-mills with brazed-in blades made of Haynes Stellite cobalt-chromi-



Shell Type End-mills Made  
by the Haynes Stellite Co.

um-tungsten alloy are now available from the Haynes Stellite Co., Unit of Union Carbide and Carbon Corporation, Kokomo, Ind. These cutters are furnished with blades of either Haynes Stellite 98M2 or Star J-Metal brazed into a steel body. Diameters range from 1 1/4 to 6 inches, with face thicknesses from 1 inch to 2 1/4 inches. These cutters are supplied ready for use. They are adapted for milling aluminum, bronze, cast iron, brass, and some steels. 98

# READY—IN 17 SECONDS

REPRODUCTIONS OF YOUR DRAFTSMEN'S DRAWINGS,  
TYPED MATERIAL, OFFICE FORMS



In this case, the operator is feeding a draftsman's pencil drawing, size 17" x 22", and a piece of sensitized paper into the machine. Smooth-running conveyor belts speed both materials around the printing cylinder... after which the drawing is automatically released, and the exposed paper goes up and across the dry-developing tank.



Here comes the Ozalid print... an exact duplicate—not a negative, of the original. You'll find it dry, ready for immediate use. And there's a very unique reason for the short time required—only 17 seconds... and for the fact that the print has black, or red, or blue lines on a white background—which-ever color was desired.

## WHY YOU MAKE PRINTS WITH THIS SPEED AND VERSATILITY

THE ANSWER is in OZALID DRY DEVELOPMENT... and what it has allowed designers and chemists to do.

Since only one developing operation is employed, the design of an Ozalid machine is extremely simplified. So compact in size you can install it in a corner of the drafting room or office. So easy to understand that any inexperienced person can quickly learn to turn out prints with maximum efficiency—using cut sheets or roll stock.

Also consider the amazing line of sensitized materials which react only to the dry principle... and offer this choice whenever you want to reproduce anything drawn, typed, printed, or photographed on translucent material:

- **Black, Red, Blue Line** standard papers which allow you to assign identifying colors to prints of different departments, to distinguish checked from unchecked prints, etc.

- **Transparent Papers, Cloths, Foils** which you use to produce Intermediate

Originals and Composite Prints or to reclaim worn or soiled drawings.

- **Opaque Cloths** which give you prints of exceptional durability.

- **NEW Dryphoto Papers** which produce beautiful reproductions with all the half-tone details, from photographic film-positives or perspective drawings.

See all of these Ozalid Prints yourself—and learn the complete story.

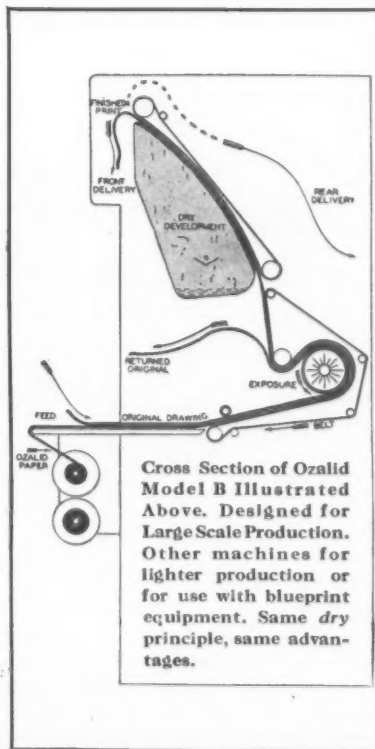
Write for "Simplified Printmaking" today.

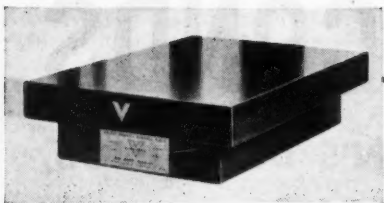


## OZALID

Division of  
General Aniline and Film Corporation  
Johnson City, New York

Ozalid in Canada—  
Hughes-Owens Co., Ltd., Montreal





Velsey Black Granite  
Surface Plate

### Velsey Black Granite Surface Plates

The State Mfg. & Construction Co., Franklin, Ohio, is placing on the market a line of Velsey surface plates made of black diamond granite for which an extremely high degree of accuracy is claimed. The type of granite used is said to

be an ideal material for surface plates, since it cannot be warped or distorted, is rustproof, non-abrasive, shock-proof, non-magnetic, and harder than metal cutting tool steel.

The Master Series Velsey surface plates in this line are lapped in series to a tolerance of 0.00005 inch surface flatness. They are regularly made in three sizes—M-12, which is 12 by 18 by 4 inches and weighs 80 pounds; the M-18, which is 18 by 24 by 4 inches and weighs 170 pounds; and the M-24, which is 24 by 36 by 6 inches and weighs 500 pounds. Surface plates of the standard series are available in similar sizes, but are lapped to a tolerance of 0.0001 inch surface flatness. Larger black granite plates can be made to order. 99

### Kux Convertible Die-Casting Machine

The Kux Machine Co., 3930-44 W. Harrison St., Chicago 24, Ill., has just added to its line a Model BH-18 hydraulic convertible die-casting machine, which has a plunger gooseneck injection unit designed for the production of lead-, tin-, and zinc-base die-castings. This machine is also equipped with a cold chamber and hand-ladling injection unit for making aluminum, magnesium, or brass die-castings. Either of these metal injection units can be dismantled and replaced by the other in less than an hour.

The zinc die-casting unit con-

sists of a bridge which supports the gooseneck, plunger, and nozzle and holds the gooseneck suspended in the melting pot with its furnace inside the frame of the machine. The plunger is operated by a hydraulic ram permanently mounted below and to one side of the melting pot. A bell-crank lever serves as the operating medium between the hydraulic ram and the plunger. This arrangement is designed to prevent oil leakage into the melting pot and furnace and to reduce to a minimum overheating of the hydraulic oil from direct overhead contact with the heated furnace.

These features tend to prolong the life of the plunger actuating mechanism and the hydraulic system.

The cold chamber unit for aluminum, magnesium, and brass consists of a bridge which carries the hydraulic operating ram and injection plunger. The plunger sleeve containing the ladling well is mounted in the back of the stationary die-plate. In using the hand ladling injection unit, a separate melting pot and furnace are required, which are available with gas- or oil-firing mechanism and an automatic temperature control device. After the cold chamber unit is mounted in place, the connection of two hydraulic hose couplings, the turning of a valve handle, and the operation of an electrical switch is all that is necessary to place the machine in operation.

Two control panels are provided for the machine—one for the operation of the plunger gooseneck injection unit and the other for the operation of the cold chamber injection unit. These control panels are electrically interlocked. Safety devices have been incorporated in the control panel which prevent the injection of molten metal into the dies unless they are closed.

These machines are available with a die space between the bars of 18 by 18 inches, 18 by 30 inches, and 50 by 25 inches. Zinc castings weighing as much as 25 pounds and aluminum castings weighing up to 10 pounds can be made under injection pressures as high as 25,000 pounds per square inch. 100

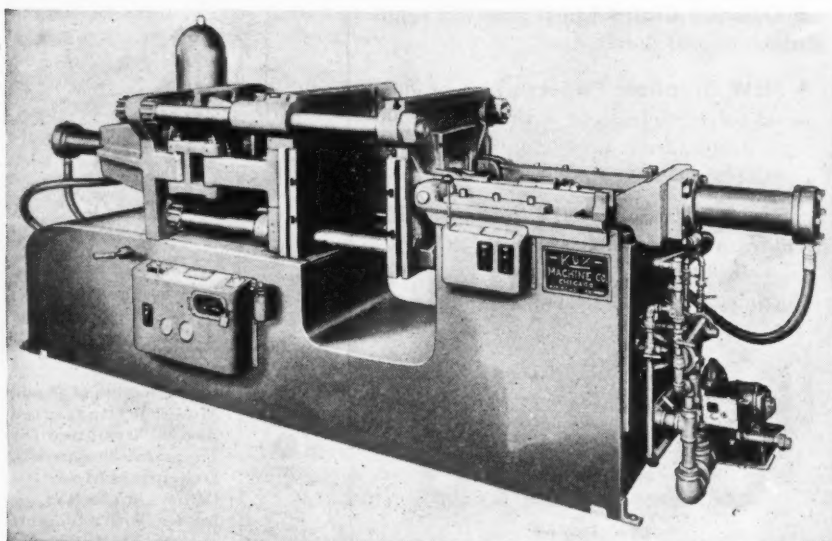
\* \* \*

### Solid Tungsten-Carbide Broaches

One of the new, more unusual applications of tungsten carbide is the solid tungsten-carbide broach, which is now made in diameters of from 1/4 to 1 inch and of moderate lengths, by Willey's Carbide Tool Co., 1340 W. Vernor Highway, Detroit 1, Mich.

\* \* \*

In large mass production plants, such as in the automotive industry, reconversion cannot be done piecemeal. It must be done as one continuous operation. Hence, there can be no reconversion now, as war demands will be with us for some time to come.



Kux Die-casting Machine which can be Quickly Converted from a Cold-chamber Hand-ladling Type to a Plunger Gooseneck Injection Type

# CROSS COUNTRY

VARD INC. produces: precision taps, thread and taper gages, cylindrical and snap gages, calipers and scales, aircraft hydraulics and gear actuators, optical lenses, filters and mirrors.



At the start of 1945, VARD'S distribution organization has run clear across the country. Pick out the dealer nearest you.

LOS ANGELES, CALIF.  
Machinists' Tool & Supply Co.  
SEATTLE, WASH.  
Campbell Hardware & Supply Co.  
SALT LAKE CITY, UTAH  
Industrial Supply Co.  
TULSA, OKLAHOMA  
Hart Industrial Supply Co.  
HOUSTON, TEXAS  
Huge-Fayle Supply Co.  
KANSAS CITY, MO.  
Fred A. Ellfeldt Co.  
MINNEAPOLIS, MINN.  
The John C. Eide Co.  
INDIANAPOLIS, IND.  
Daco Tool & Engineering Co.

BIRMINGHAM, ALA.  
Tool Engineering Service  
COLUMBUS, OHIO  
Smith Bros. Hardware Co.  
ROCHESTER, N. Y.  
The Sidney B. Roby Co.  
BRIDGEPORT, CONN.  
Ward-Nagel Tool Supply Co., Inc.  
SAN FRANCISCO, CALIF.  
Douglas & Sturgess  
VANCOUVER, B. C.  
Hall Equipment & Products Ltd.  
DENVER, COLORADO  
Johnson Supply Co.  
OKLAHOMA CITY, OKLA.  
Hart Industrial Supply Co.  
NEW ORLEANS, LA.  
Murray-Baker-Frederic, Inc.  
DES MOINES, IOWA  
Globe Mch. & Supply Co.  
MILWAUKEE, WISC.  
Triplex Supply Co.  
CINCINNATI, OHIO  
The Bingham Tool & Supply Co.  
ATLANTA, GA.  
Fulton Supply Co.  
TOLEDO, OHIO  
Klatt & Wood Machinery

SYRACUSE, N. Y.  
Syracuse Supply Co.  
NEW YORK, N. Y.  
Walter D. Briggs Co.  
PORTLAND, ORE.  
The General Tool Co.  
SPOKANE, WASH.  
W. R. Matthews Mch.  
WICHITA, KANSAS  
White Star Mch. & Supply Co., Inc.  
DALLAS, TEXAS  
United Tool & Supply Co.  
ST. LOUIS, MO.  
Mill Supply & Mch. Co.  
YANKTON, S. D.  
Dakota Supply Company  
CHICAGO, ILL.  
Engis Equipment Co.  
MEMPHIS, TENN.  
Hays Machine Tool Co.  
PITTSBURGH, PA.  
A. D. "Bert" Sutherland  
DETROIT, MICH.  
B. A. Taylor Company  
WORCESTER, MASS.  
Ramsdell Industrial Supply Company  
PHILADELPHIA, PA.  
Carlin & Company

**VARD INC.**  
PASADENA 8, CALIFORNIA

## A Motion Picture to Help Foremen Solve Their Problems

An unusual motion picture film, which requires about forty minutes to show, has been developed by the Chance Vought Aircraft Division of the United Aircraft Corporation, at Stratford, Conn. This film has been called "Combat Team," and is an integral part of the training program at the Chance Vought plant. It has been shown to all the supervisors in the plant with the rank of foreman or higher. It is also being shown to 1500 lead-men in the plant.

The object of the picture is to make the foreman give thought to the fact that there is a right and a wrong way to handle most personnel problems in the shop. Furthermore, the picture emphasizes the value of staff departments and the aid that they can render the supervisors. It creates in the foreman a desire to know more about these departments and what they do.

Briefly, the picture shows three foremen in the Chance Vought plant spending an evening together at the home of one of them. Their conversation brings out typical difficulties encountered by supervisors. Then flashbacks to the shop show how the problems ought to be solved.

It required more than four months to make this picture. The first step was a painstaking survey of the everyday problems confronting supervisors—from the head of the management right down to the shop lead-men. The problems revealed by this survey as the most persistent and puzzling were then selected for use in the film.

The picture should be of great value in industry generally. The film can be borrowed for showing to foreman groups by addressing Training Division, Chance Vought Aircraft, Stratford, Conn.

## Motion Picture of Gas Turbine Action

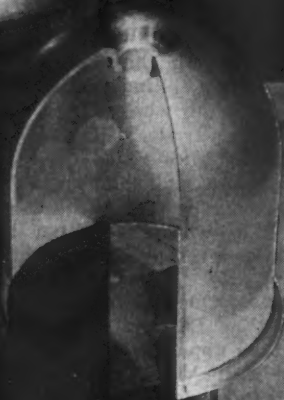
The gas turbine, which is the newest type of prime mover, has been made the subject of a motion picture film entitled "Tornado in a Box," by the Allis-Chalmers Mfg. Co., Milwaukee, Wis. This picture explains for the first time in film form the development and operation of the gas turbine, which has been hailed as the "power plant of the future."

The picture makes the manner of operation of the gas turbine readily understandable; it also indicates that a great deal more of the tremendous engineering effort already applied to the solution of the gas turbine problem must still be put into gas turbine development before complete success will be achieved. The film will be lent to industrial and engineering groups interested in showing it. It is a 16-millimeter film for use on sound projectors only.



Pieces of Aluminum 0.062-inch Thick are Spot-welded together with a 48,000-ampere Current. The Ignitron Control Measures off Precisely the Eight Cycles Required for the Welding Current to Do the Work. The Electronic Heat Control Permits an Infinite Number of Settings for Spot-welding Different Thicknesses of Metal

**I-P-M**



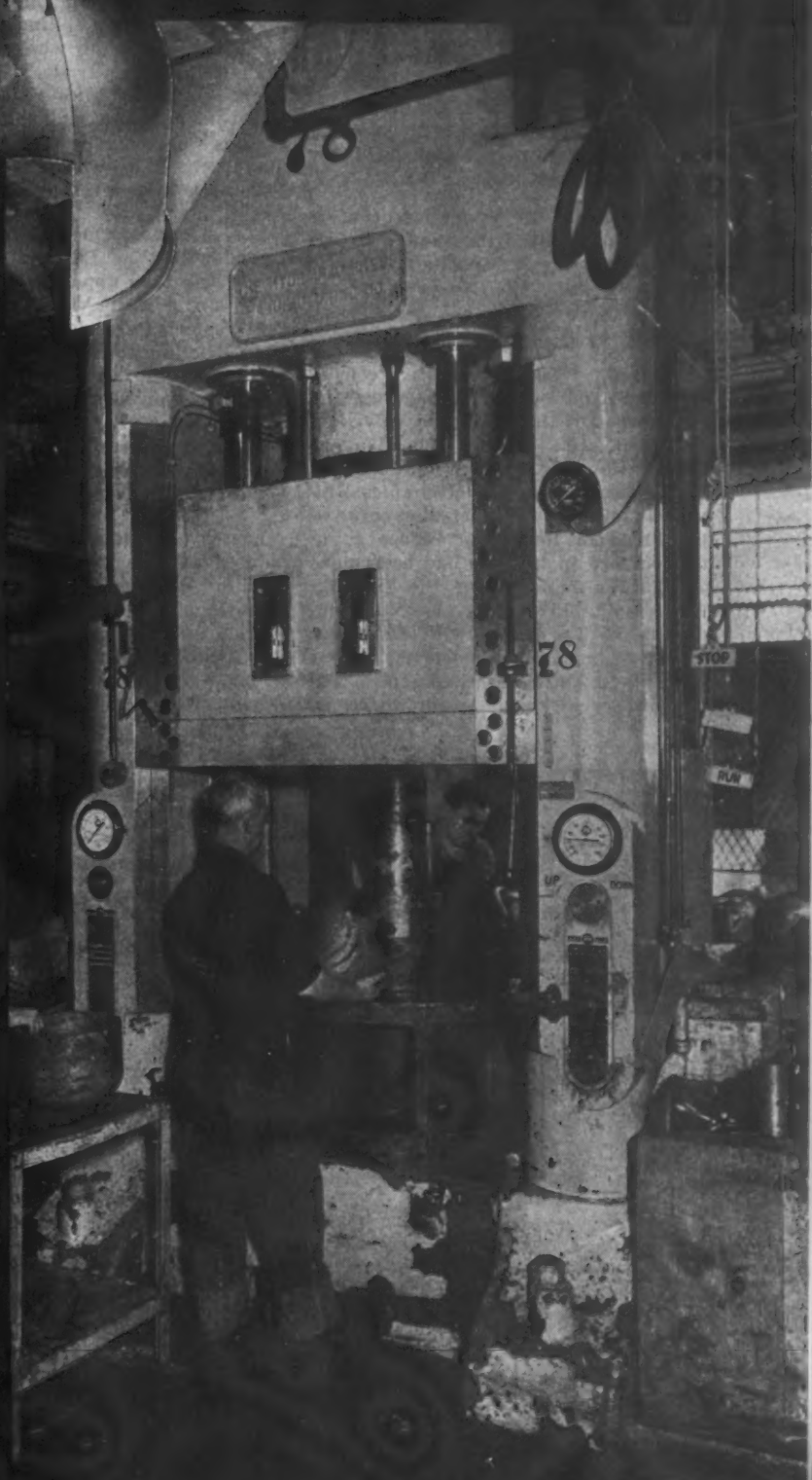
Worcester Portland Steel Company employs this type of the I-P-M VASTON VASTO press for drawing aircraft propeller hub cones from No. 1 aluminum alloy. Formerly a hub cone of this design was made from "cast" with a material weighing up to 15 pounds per square inch. The I-P-M VASTON VASTO press draws the hub cone from the form of a cone.

When you have located the position of the hub cone, the metal part is drawn into the form of a cone. The I-P-M VASTON VASTO press draws the hub cone from the form of a cone. The I-P-M VASTON VASTO press draws the hub cone from the form of a cone.



**THE HYDRAULIC PRESS MFG. CO.**  
Mount Gilead, Ohio, U. S. A.

Branch Offices—New York, Philadelphia, Detroit and Chicago.  
Representatives in Principal Cities.



# News of the Industry

## California and Washington

HARRY W. HAHN has been appointed vice-president in charge of engineering and production for the H. L. Harvill Mfg. Co., Vernon, Calif. Mr. Hahn was previously plant manager of the Die Cast Corporation (Warner Mfg. Co.) in Glendale, Calif., and prior to that was president of the Plastic and Die Cast Corporation.

RACY D. BENNETT has resigned as manager of the Hydraulic Division, Vinco Corporation, and will establish an office as consulting engineer in or near Los Angeles, Calif.

OMEGA TOOL Co. announces that it has recently moved into new quarters at 76 University St., Seattle 1, Wash.

## Illinois

ARCH A. WARNER has been elected president and general manager of the Rockford Drilling Machine Division, Rockford, Ill., of the Borg-Warner Corporation. Mr. Warner was formerly works manager of the Mechanics Universal Joint Division of the corporation, also in Rockford. Before going to Rockford in 1941, he had been since 1938, sales manager for the Division in Detroit. Previously, he was connected for ten years with Universal Products, and for almost as long a period with the Zenith and Stromberg-Carlson organizations. He succeeds

E. C. TRANER, who, after more than twenty-five years with the company, retires from the active direction of operations to become chairman of the advisory board.

NORMAN F. CLAYBORNE, president of Clayborne Distributors, Ltd., 209 S. La Salle St., Chicago, Ill., has announced plans to organize a selling pool among small manufacturers who wish to participate in foreign trade. This development is being encouraged by the Government as a partial solution to the surplus war goods problem. Interested manufacturers can obtain further information from Mr. Clayborne.

D. C. STORMS, formerly general superintendent of the St. Louis Ordnance Plant, has been appointed works manager of the East Alton, Ill., plant of the Western Cartridge Co., succeeding F. A. SCHOTTERS, who has been appointed to the staff of the Olin Corporation, New Haven, Conn., parent corporation of the Western Cartridge Co. Mr. Schotters will handle special assignments involving general administration and engineering development.

LYMAN H. BELLOW, has been appointed sales manager of the Sheldon Machine Co., Inc., Chicago, Ill., manufacturer of Sheldon precision lathes and Vernon milling machines and shapers. Mr. Bellows was previously connected with the Electrical Tool Division of the Stanley Works, New Britain, Conn.

BODINE ELECTRIC Co., 2254 W. Ohio St., Chicago, Ill., manufacturer of fractional-horsepower motors, has broken ground for a two-story addition to its plant, which will enlarge the present capacity by approximately 50 per cent.

E. B. DULLINGER has been appointed factory manager of the Continental Can Co.'s recently acquired Clearing-Owens plant, Chicago, Ill. K. W. HOUCK has been appointed industrial engineer of the same plant.

TOOL EQUIPMENT Co., 24 S. Pulaski Road, Chicago, Ill., has opened a branch office at 419 W. State St., Room 110, Rockford, Ill. M. P. HARTNETT is in charge of the new office.

## Indiana

GILBERT D. DILL has been appointed a member of the sales engineering staff of the American Foundry Equipment Co., Mishawaka, Ind. He will be engaged in the development and application of Wheelabrator airless abrasive blast cleaning equipment in the rolling mill industry. Mr. Dill was previously purchasing engineer for Arthur G. McKee & Co., of Cleveland, in charge of purchases involved in the construction of two wartime steel plants.

JOHN C. STRAUB, for the last thirteen years associated with the Research Laboratories Division of General Motors



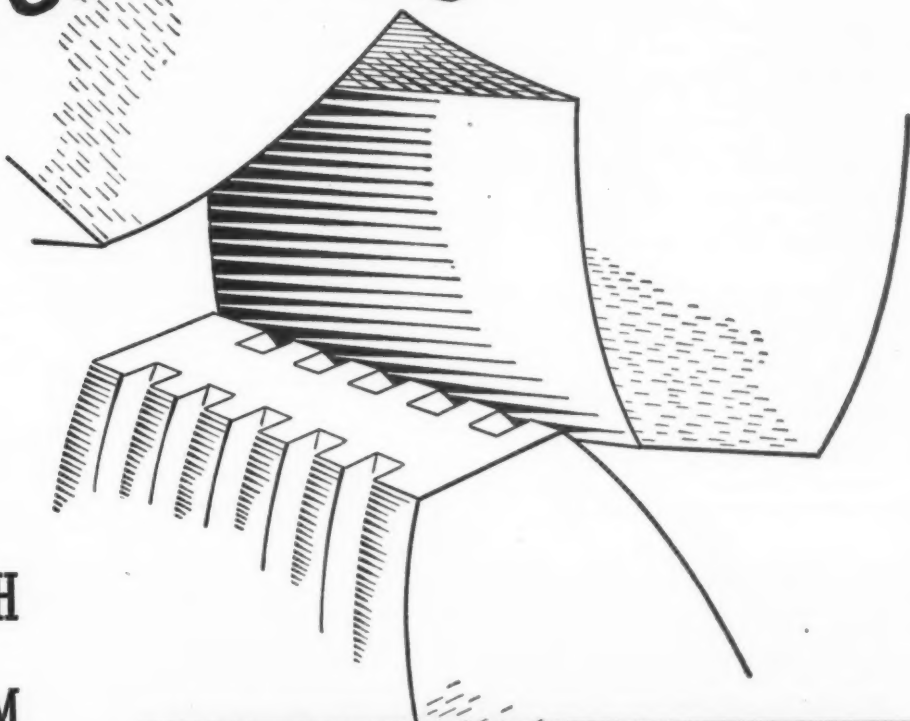
(Left) Arch A. Warner, Newly Elected President and General Manager of Rockford Drilling Machine Division, Borg-Warner Corporation. (Right) E. C. Traner, Retiring President and Now Chairman of Advisory Board

# Now: CURVE-SHAVING

Available  
exclusively on  
Michigan Rack  
and Rotary  
Gear Finishers

A  
Finishing Process  
which produces  
Gears with  
**END-RELIEVED TEETH**  
having  
**TRUE INVOLUTE FORM**  
over their entire  
length

With this process any desired amount of relief (to prevent end loading of teeth due to shaft deflection) can be quickly and accurately produced and re-produced automatically at one or both ends of the tooth without destroying correct involute form.



## MICHIGAN TOOL COMPANY

7171 E. MCNICHOLS ROAD . . DETROIT 12, U. S. A.

MACHINERY, January, 1945—237

Corporation, Detroit, Mich., has been appointed research engineer of the American Foundry Equipment Co., Mishawaka, Ind.

## Michigan

HAROLD E. HARDENBROOK has been appointed general works engineer for all Buick plants, with headquarters at Flint, Mich., succeeding FRANK ELWELL, who is retiring. Mr. Hardenbrook has been works engineer at the Buick Melrose Park plant since the fall of 1940, and has directed the plant engineering and maintenance operations at that division throughout its early development and the war period.

ALLEN-BRADLEY Co., Milwaukee, Wis., manufacturer of electric control apparatus, announces the appointment of E. B. DEWEY as sales representative for the complete Allen-Bradley line. Mr. Dewey's offices are in the American National Bank Bldg. of Kalamazoo, Mich. He will cover southwestern and central Michigan and provide sales engineering service in that area.

CARBOLLOY COMPANY, INC., Detroit, Mich., has established a branch office at 924 M & M Bldg., 1 Main St., Houston 2, Tex., with A. J. ROP in charge as sales and service engineer. A branch office has also been established at 743 N. 4th St., Milwaukee, Wis., where FRANK J. STAROBA and A. F. SCHLUMPF will make their headquarters.

MIDLAND STEEL PRODUCTS Co., DETROIT PRESSED STEEL DIVISION, 6660 Mt. Elliott Ave., Detroit, Mich., has made arrangements to increase its floor space by 105,000 square feet through the purchase of a building adjacent to its plant and the erection of a new press building.

JAMES SWANSON has been appointed assistant purchasing agent of the Clark Equipment Co., and will have charge of all buying activities for the Clark Tractor Division at Battle Creek, Mich. Mr. Swanson succeeds the late D. E. LEACH.

MARION T. DAVIS, 144 Walker St., S. W., Atlanta, Ga., has been appointed manufacturer's agent for the ECLIPSE COUNTERBORE Co., Detroit, Mich., in southeastern United States.

## New England

R. DONALD RUSDEN, formerly chief engineer of the Textile Finishing Machinery Co. and the T. F. M. Corporation, is now connected with the Rice Barton Corporation, Worcester, Mass., as sales engineer.

WELSH MFG. Co., Providence, R. I., has been appointed sole distribution agency of the new "Fog-Free" goggle made by the H. L. BOUTON Co., Buzzards Bay, Mass.

## New Jersey

W. CORTLYN RHODES has been appointed chief production engineer of Air Associates, Inc., Teterboro, N. J. Mr. Rhodes has been connected with the company since 1940, when he joined the organization as a methods engineer. He subsequently became attached to the production engineering department, and has served in that capacity since May, 1942, until his present appointment. Mr. Rhodes has been chairman of the New York Chapter of the American Society of Tool Engineers for the last two terms.

JOHN THOMAS GILLESPIE, JR., has been appointed manager of export sales for the Watson-Stillman Co., Roselle, N. J. During the last two and one-half years, Mr. Gillespie has been with the Shipbuilding Division of the War Production Board, serving as Chief of Staff Branch.

KENNETH MCCREARY was elected president of the Goetze Gasket & Packing Co., Inc., New Brunswick, N. J., at a recent meeting of the board of directors, succeeding the late FREDERICK GOETZE. Mr. McCreary has been associated with the company since 1932.

LEOPOLD H. P. KLOTZ has been elected president of the Luscombe Airplane Corporation, Trenton, N. J., succeeding A. C. HASTINGS, JR., who has retired. Mr. Klotz was previously vice-president and treasurer of the company.

CHARLES E. SCHOLL has been appointed general manager of Federal Electric Products Co., Inc., Newark, N. J. He was formerly sales manager of the Bright Light Reflector Co., Brooklyn, N. Y.

## New York

EASTERN MACHINERY Co., 1000-1034 Tennessee Ave., Cincinnati 29, Ohio, has opened a branch office in the Chrysler Building, Lexington Ave. at 42nd St., New York City, under the management of JOHN W. LEREW. For more than four years Mr. Lerew has been in charge of the purchase and redistribution of used machine tools for the British Purchasing Commission, and has also been technical advisor on problems relating to the selection and use of machine tools for the British and India Supply Missions.

INDUSTRIES COUNSEL ASSOCIATES, INC., 280 Madison Ave., New York 17, N. Y.,

has been organized to serve industry in the field of public relations, engineering analyses of plant facilities, market research, product research and design, the development of sales and distribution systems, and labor relations. RUPERT S. STERN is president of the corporation.

DEAN SWIFT, formerly of Seattle, announces the opening of offices in the Chanin Bldg., 42nd St. and Lexington Ave., New York 17, N. Y. He will represent the Western Gear Works' plants at Seattle, Wash. and Lynwood and Vernon, Calif., and the Western Gear Works' associate plant, the Pacific Gear and Tool Works, of San Francisco.

J. H. CALLAN has been elected president of the Crucible Steel Company of America, with headquarters in New York City. Mr. Callan has been associated with the company for twenty-four years, and has been a member of the board of directors and of the executive committee for the last six years.

HOWARD LINN EDSALL, until recently advertising manager of the Ajax Metal Co., Philadelphia, Pa., and affiliates, has been appointed advertising and sales promotion manager, Tube and Equipment Department, RCA Victor Division, Radio Corporation of America, New York City.

E. V. CRANE has resigned his post as chief of development engineering at the Brooklyn plant of the E. W. Bliss Co. after an association of more than twenty-four years, and is engaging upon research investigations in the field of press-worked materials.

L. H. SKOUGOR has been appointed general manager of the production planning department of Continental Can Co., Inc., 100 E. 42nd St., New York 17, N. Y. Mr. Skougor was formerly manager of the company's plant in Jersey City, N. J.

GEORGE W. MITSCH, since 1935 assistant manager of foundries of the Madison and St. Louis plants of the American Car and Foundry Co., 30 Church St., New York City, has been made operating manager of foundries.

L. R. BOULWARE, former operations vice-chairman of the War Production Board, has been appointed to the staff of Charles E. Wilson, president of the General Electric Co., as a consultant on marketing and merchandising.

JAMES E. POWER has been appointed eastern sales manager of the Mechanical Goods Division, United States Rubber Co., Rockefeller Center, New York City.

FRANK M. BATES, INC., industrial consultants, announce the opening of a New York office at 41 E. 42nd St., New York 17, N. Y.



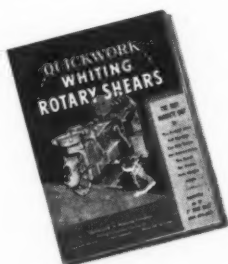
# Make parts for bombs today— for farm machinery tomorrow!

THERE'S NO RECONVERSION PROBLEM WITH THIS VERSATILE METAL WORKING MACHINE

## YOUR QUICKWORK SHEAR WILL

- Cut straight lines
- Cut narrow strips
- Cut beveled edges
- Cut irregular shapes
- Cut openings
- Joggle

Make clean cuts without burrs  
at high speed—in a single pass



Write  
for  
Bulletin.

Quickwork shears bought now for war production purposes will serve you equally well after reconversion to peacetime manufacturing. Sturdy and versatile, Quickwork shears that turn out parts for bombs today can play as important a role in the post-war manufacture of farm machinery.

Quickwork shears, with capacities ranging from 16-gauge sheet metal to one-inch mild steel, offer a wide range of service—joggle, flange; cut straight lines, circles, openings, and irregular shapes. Check their possibilities today—write for complete information.

QUICKWORK-WHITING DIVISION

# WHITING

CORPORATION

15673 LATHROP AVENUE, HARVEY, ILLINOIS

## Ohio

L. R. HAWKINS, who has served for three years in the Tools Branch of the War Production Board, has returned to serve as district manager at Los Angeles, Calif., for the Warner & Swasey Co., Cleveland, Ohio. HENRY HERKNER has been transferred from the West Coast office to Newark, N. J., and CHARLES T. WAY has been appointed representative in the recently opened office in Atlanta, Ga. FRANK J. PELICH has been made district manager at Philadelphia. W. J. PELICH and A. HUGH HOWARD have been made sales engineers in the Cambridge, Mass., and Chicago areas, respectively.

R. W. DAVIS has been appointed general manager of the Allis-Chalmers Mfg. Co.'s Norwood, Ohio, works, which is engaged principally in the production of electrical equipment and centrifugal pumps in the smaller sizes. He was previously assistant manager of the Allis-Chalmers electrical department at Milwaukee, Wis., and just prior to receiving his present appointment had been on leave, serving as director of the electrical equipment branch in the War Production Board.

LEON R. BAKER has been appointed European manager for Lempco Products, Inc., Bedford, Ohio, manufacturers of automotive and industrial machine tools, parts, and equipment. The headquarters of the European office will be in London. Mr. Baker has been actively connected with the machine tool industry in Great Britain and the United States for the last twenty years. At one time he was associate editor of the British publication *MACHINERY*.

J. RINGEN DRUMMOND has been appointed assistant factory manager of the Timken Roller Bearing Co., Canton, Ohio, succeeding H. M. RICHEY, who became factory manager last December. Mr. Drummond joined the Timken organization in 1926 as chief inspector, and later served as assistant superintendent of the company's Columbus, Ohio, plant. Since 1932 he has been doing experimental engineering in the Canton plant.

E. PEERCE LAKE has been appointed vice-president and general manager of the Warren City Mfg. Subsidiary, at Warren, Ohio, of the Graham-Paige Motors Corporation. Mr. Lake was vice-president and general manager of the Columbia Machinery & Engineering Corporation, Hamilton, Ohio, before joining the Graham-Paige organization.

L. S. STILWELL, formerly sales representative of the Western Automatic Machine Screw Co. at Springfield, Ohio, has been named branch manager of the firm's Cleveland sales office at 641 Engineers Building. Mr. Stilwell replaces W. W. KIMBROUGH, who has been made

branch manager of the Detroit office and warehouse.

EDWARD E. HELM, since 1928 district sales manager in Philadelphia for the Reliance Electric & Engineering Co., Cleveland, Ohio, has been appointed general sales manager. KENNETH S. LORD will succeed Mr. Helm as manager of the Philadelphia district. He has been connected with the company since 1926.

BOYE & EMMES MACHINE TOOL Co., Cincinnati 15, Ohio, announces the appointment of the following dealers: JACK BREWER, Los Angeles, Calif.; SCHELLENBACH MACHINE & TOOL Co., San Francisco, Calif.; and SULLIVAN VALVE & ENGINEERING Co., Butte, Mont.

G. RICHARD YOUNG has been appointed director of purchases for the Weatherhead Co., Cleveland, Ohio. He was formerly connected with the Westinghouse Electric & Mfg. Co. at Lima, Ohio, in the capacity of assistant purchasing agent.

DEVILBISS Co. announces the removal of its Cincinnati district sales headquarters to 410 American Bldg., Central Parkway and Walnut St., where larger facilities are available.

ALAN DALE has been elected vice-president of the Shook Bronze Corporation, Lima, Ohio. He will have charge of sales of finished bronze bushings and bearings, as well as cored and solid bronze bars.

ALLIED STEEL PRODUCTS, INC., NBC Bldg., Cleveland 14, Ohio, has recently taken over the sole selling rights of the Pittsburgh-Cambria Steel Co.'s line of tool steel.

## Pennsylvania

ALUMINUM Co. OF AMERICA, Pittsburgh, Pa., announces several changes in its Sales Engineering and Development Division: FRANK JARDINE, who has been in charge of development work in Cleveland, has been given the title of manager of Development Division, Cleveland branch; JOHN R. WILLARD has been placed in charge of the Sales Development Division at New Kensington, Pa.; and B. J. FLETCHER has been appointed chief engineer of the New Kensington branch.

ACCURATE DESIGNING & MFG. Co., 5229 D St., Philadelphia 20, Pa., has been organized by Harry Adolph Greenfield, formerly supervisor of the Duncan Tool Designing Co., for the purpose of designing and manufacturing products and machinery for the plastic, textile, and metal-working industries, including tools, dies, molds, jigs, and fixtures.

S. M. RUST has retired as president of the Rust Engineering Co., Pitts-

burgh, Pa., to become chairman of the board. S. M. RUST, JR., who has been serving as executive vice-president, has been elected president of the company, which is engaged in engineering design and construction of complete industrial plants.

JOHN J. MURPHY has been appointed purchasing agent of the Atlas Metal Stamping Co. and the Atlas Tool & Designing Co., Castor and Kensington Aves., Philadelphia 24, Pa. EDWARD G. HUGHES, formerly purchasing agent, has been made personnel manager.

PAUL M. MUELLER has been made chief engineer of the Blaw-Knox Co., Pittsburgh, Pa., in charge of development. Mr. Mueller has been headquarters engineer for the Revere Copper & Brass Co., New York City, during the last nine years.

PRESTON J. GEARHART has been appointed assistant district manager of the Berwick, Pa., plant of the American Car and Foundry Co. He has been connected with the company since 1912.

## Wisconsin

WILLIAM H. WEIMER has been elected president of the Davis & Thompson Co., Milwaukee, Wis. Mr. Weimer was formerly executive vice-president of the firm. His service with the company dates back to its organization in 1911, and has been continuous, with the exception of a brief period during which he was associated with the Avery Tractor Co. and the Globe Union Mfg. Co. G. L. OTTO, chief engineer of the company for the last twelve years, succeeds Mr. Weimer as vice-president. In this position, Mr. Otto will direct all engineering and development work.

W. F. KURFESS has been appointed manager of the Milwaukee plant of Joseph T. Ryerson & Son, Inc., succeeding George W. Smith, who died suddenly last September. Mr. Kurfess had been on active duty with the Navy in the Bureau of Ships and in the Office of Procurement and Materials since September, 1941, with the rank of commander. Prior to his war service, he was an executive of the Ryerson company in Chicago.

\* \* \*

The scarcity of electronic tubes for radios and similar equipment is well known. To meet this scarcity, new methods have been developed for producing such tubes more quickly. Plastics are now being used for tube bases, and according to *Modern Plastics*, one molding company has developed a completely automatic system for producing these plastic bases.

# PINES *Automatic* BENDING CUTTING MACHINING TUBES and RODS

## BENDER

The only full automatic bender with push button control. Operated by inexperienced workers. Bends anything that can be bent. No external piping; no levers; no maintenance; high speed; simple in construction; compact; ultimate in design.

## PROFILER

Will automatically burr, bore, face, center, thread, turn, drill, ream or chamfer one or both ends of tubes and rods, at high production speeds. Combines operations. Three sizes, single and double spindle, to meet every possible machining application.

**PINES Automatic Machines**  
Pay for themselves-quickly.  
Let Us Prove It!

## CUT-OFF

Rotary, Friction Wheel, Abrasive, — automatic operation.  
The right type machine for every cut-off application.



# PINES ENGINEERING CO., INC.

Write for Catalogs

690 PRAIRIE • AURORA, ILLINOIS • Phone Aurora 2-7608

**SPECIALISTS IN TUBE FABRICATING EQUIPMENT**

MACHINERY, January, 1945—241

## Obituaries

### S. R. Bergman

S. R. Bergman, consulting engineer in the Thomson laboratory of General Electric's Lynn (Mass.) River Works, died on November 25 at the age of sixty-seven years. Mr. Bergman was born in Sweden on May 23, 1877. He graduated in mechanical engineering from the Royal Institute of Technology in Stockholm, in 1899, and took a post-graduate course the next year at the Electrical Institute of Karlsruhe, Baden, Germany. He was employed by General Electric as a student engineer in 1902, and in 1910 was placed in charge of the Experimental Motor Laboratory at the Lynn Works of the company. Since 1919 he had been a consulting engineer at that plant.

Mr. Bergman held 53 patents covering motors and generators. Among his inventions were the single-phase capacitor motor developed in 1913 in cooperation with the late Dr. Charles P. Steinmetz, and the direct-current generator for arc welding that is still a standard in the industry. He developed, in 1920, the squirrel-cage repulsion motor.

In 1934 he was given a Charles A. Coffin foundation award by the General Electric Co.

GEORGE E. BECHTEL, vice-president of the Trundle Engineering Co., Cleveland, Ohio, since 1938, died on December 4 following a heart attack, at the age of sixty-one years. Mr. Bechtel was travelling on a sleeper from Cleveland to New York at the time he was stricken. He had been attending sessions of the Association of Consulting Management Engineers and the Society for the Advancement of Management in Cleveland. Mr. Bechtel was a native of Warren, Ind., and went to work as a machinist with the old Haynes Motor organization at Kokomo, Ind., shortly after completing high school there in 1903. He was subsequently connected with production engineering activities of various other automobile concerns, including White Motor and Nash. Mr. Bechtel joined the Trundle organization on December 5, 1928, and for fifteen years was engaged in its management activities for scores of concerns.

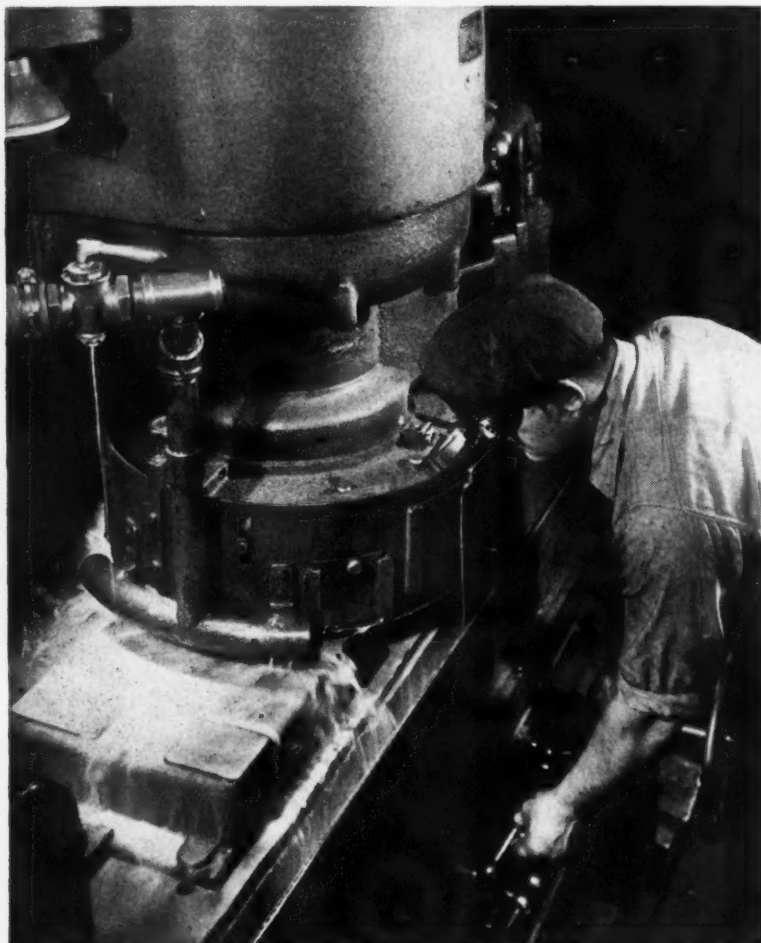
ROLAND G. JUSTUS, manager of industrial sales of the Westinghouse Air Brake Co., Wilmerding, Pa., died on November 30 in the Norton Memorial

Hospital, Louisville, Ky. He was taken ill suddenly while on a business trip in Louisville. Mr. Justus started with the company in January, 1911, as a clerk in the St. Louis office. He later became industrial representative in the southwestern district, and in June, 1932, was made general representative of the company in that district. He had been manager of industrial sales since July 1, 1940.

\* \* \*

### Bullard Receives Fifth Army-Navy Production Award

For the fifth time, the Army-Navy Production Award has been given to the Bullard Co., Bridgeport, Conn. Within a day of the award, the company also received a letter from Rear Admiral J. W. A. Waller, who termed the work done by the Bullard organization on an aircraft torpedo contract a "miracle of production." Admiral Waller said that the Bullard Co. had "developed a technique in the manufacture of torpedoes—a product utterly different from your normal type of work—which contributed substantially to decreased cost and elimination of hand work."



Surface-grinding Rough Castings Direct from the Foundry on a Hanchett Mfg. Co.'s Grinder at the Plant of the Allis-Chalmers Mfg. Co., Milwaukee, Wis. The Bottom Edge of the Casting and Four Pads on the Top are Ground, Removing about 1/16 Inch of Stock. The Work is Held on a Magnetic Chuck. This Method has been Found Both Satisfactory and Economical

**PROVEN  
on every  
Battlefront**



**NOW READY  
for your  
HYDRAULIC  
EQUIPMENT**

## *Greer* HYDRAULIC ACCUMULATORS

Here is a simple, small, low-cost accumulator that sets new standards of performance. Greer Hydraulic Accumulators, battle-tested under the severest conditions on military equipment, are now available for your hydraulic system.

**Reliable** — The cross-section shows the simplicity of construction which accounts for the reliability and low cost of Greer Hydraulic Accumulators. The one-piece chrome-molybdenum seamless steel shell has a completely enclosed synthetic rubber bag with an integrally molded air valve. No welds. No joints. No packing. No air leaks.

**Operation** — The accumulator is precharged from the regular shop air supply through an inexpensive booster pump, just like a pneumatic tire. Recharging is necessary only every three or four months.

**Sizes, Proportions** — Standard sizes range from 4-1/8 D by 8-1/16 long for the 1/3 gallon accumulator, to 12-3/4 D by 52-5/8 long for the 25 gallon accumulator. Operating pressures are from 1000 to 3000 psi, depending upon capacity. For larger capacities, multiples of standard sizes may be hooked up in parallel. Shell proportions and shapes may be varied from standard to suit any condition.

**Low Cost** — The low cost of Greer Hydraulic Accumulators permits the application of hydraulics in highly competitive portable and stationary equipment.

**Engineering Assistance** — Our hydraulic engineers will gladly help you with your problem. Write.



**GREER PRODUCTS CORPORATION**

39 West 60th Street, New York 23, N. Y.

# New Books and Publications

**OCCUPATIONAL ACCIDENT PREVENTION.** By Harry H. Judson and James M. Brown. 234 pages, 5½ by 8¼ inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, \$2.75.

This book has been written to meet the need for a textbook which will serve as a complete reference manual for industrial safety engineering courses. The material presented in the book originated from instructors' notes prepared for such courses given under the War Training Program. Every effort has been made to make the book complete and at the same time to eliminate all unnecessary detail. It deals not so much with safety itself as with fundamentals in plant operation for preventing accidents, based on modern tested methods. The book is divided into four sections under the following headings: Introduction; Improvement of Work Procedures; Improvement of Plant; and Safety Activities. There are two appendixes, one of which gives the American standard method of compiling industrial injury rates, and the other a list of sound slide films on the subject of accident prevention.

**AIR COMPRESSORS.** By Eugene W. F. Feller. 460 pages, 5½ by 8½ inches; 414 illustrations. Published by the McGraw-Hill Book Co., 330 W. 42nd St., New York 18, N. Y. Price, \$4.50.

This book is intended primarily for the operating engineer and mechanical engineering student interested in air compressors and compressed air. The author states that he finds many of the books now available on thermodynamics highly theoretical and of little practical help to the man responsible for operating and maintaining air compressors or supplying compressed air for industrial use. He has, therefore, endeavored to present the material in such a way that the reader will become familiar with all types of compressors, will know how they operate, and will learn what points to consider in their selection. Installation, operation, and maintenance information is presented in detail. In compiling this information, the author has benefited considerably by twenty-three years of plant experience.

**THE INDUSTRIAL SUPERVISOR.** By John M. Amiss and Traver C. Sutton. 243 pages, 5½ by 8 inches. Published by the Ronald Press Co., 15 E. 26th St., New York 10, N. Y. Price, \$3.

The object in preparing this book, according to the authors, has been to

provide supervisors, both experienced and inexperienced, with information that will develop their ability to handle their work in the most efficient manner. Probably the best way in which a brief review can convey the contents of this book is by listing the seventeen chapter headings: General Supervisory Responsibilities; General Qualifications of a Supervisor; Training in Industry; Leadership Characteristics; Cooperation; Discipline and Morale; Attendance and Punctuality; Job and Man Analysis; Industrial Safety; Fire Protection and Prevention; The Supervisor and Time Study; Labor Turnover; Planning; Equipment; Direct Labor Costs; Overhead Expense; and Ethics of Supervision.

**ALIGNMENT CHARTS.** By Maurice Kraitchik. 94 pages, 6 by 9 inches. Published by the D. Van Nostrand Co., Inc., 250 Fourth Ave., New York 3, N. Y. Price, \$2.50.

This book describes the methods and techniques involved in constructing alignment charts. Such charts represent in graphic form a mathematical law. By means of these charts, much time is saved when a particular equation must be solved repeatedly, using different sets of values for the variables. The opening section of the book reviews the algebra, analytic geometry and determinants necessary for an understanding of the methods of chart construction. The representation of various equations is then discussed and illustrated by means of exercises. Applications are made to the fields of engineering, chemistry, manufacturing, and investments.

**PLASTICS DIRECTORY.** 247 pages. Published by the Society of the Plastics Industry, Inc., 295 Madison Ave., New York 17, N. Y. Price, \$2.50.

This new 1944-1945 directory of plastics lists more than 700 different plastics products, together with the names and addresses of the manufacturers, in a classified product index. It also contains a separate alphabetical list of the 440 members of the Society. In addition, the directory includes for the first time a material index and a machine index, each containing the names of producers. The section entitled "Who's Who in Plastics" gives the names and addresses of executive, sales, and engineering personnel of the member companies.

**SETTING UP AND OPERATING A WELDING BUSINESS.** 100 pages, 5¾ by 8½ inches. Published by the James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio.

The 1944 edition of this handbook represents an extensive revision of the previous edition (1940). It deals exclusively with the engineering properties of cast metals, and has been prepared especially for use by those who design castings and who specify or purchase castings for industrial products.

**CAST METALS HANDBOOK (1944).** 745 pages, 6 by 9 inches; 258 illustrations, 204 tables. Published by the American Foundrymen's Association, 222 W. Adams St., Chicago 6, Ill. Price, \$6.

## Coming Events

**JANUARY 8-12**—Annual meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Book-Cadillac Hotel, Detroit, Mich. Further information can be obtained from John A. C. Warner, secretary and general manager, 29 W. 39th St., New York 18, N. Y.

**MARCH 19-22** — MACHINE AND TOOL PROGRESS EXPOSITION under the auspices of the AMERICAN SOCIETY OF TOOL ENGINEERS, to be held in the Cleveland Auditorium, Cleveland, Ohio. Adrian L. Potter, executive secretary, 1666 Penobscot Building, Detroit 26, Mich.

**MARCH 19-22**—Annual meeting of the AMERICAN SOCIETY OF TOOL ENGINEERS in Cleveland, Ohio. Adrian L. Potter, executive secretary, 1666 Penobscot Building, Detroit 26, Mich.

**APRIL 4-6**—National Aeronautic Meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Hotel New Yorker, New York City. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York 18, N. Y.

**APRIL 16-18**—Spring meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS in Boston, Mass. C. E. Davies, secretary, 29 W. 39th St., New York 18, N. Y.

**APRIL 30-MAY 4**—Forty-ninth annual meeting of the AMERICAN FOUNDRYMEN'S ASSOCIATION in Detroit, Mich. For further information, address American Foundrymen's Association, 222 W. Adams St., Chicago 6, Ill.

**JUNE 17-21**—Semi-annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS in Chicago, Ill. C. E. Davies, secretary, 29 W. 39th St., New York 18, N. Y.

**OCTOBER 1-3** — Fall meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS in Cincinnati, Ohio. C. E. Davies, secretary, 29 W. 39th St., New York 18, N. Y.

# IMPROVED PULL-UP BROACHING MACHINES

by  
*Colonial*

8 Models in 6 to 25 tons rating  
and 36 to 60 inch strokes.

40% overload capacity . . . . Lower operating oil pressure for a given tonnage rating . . . . Minimum floor space—vertical motor mounting within column . . . . Automatic Broach handling . . . . Adjustable broach handling bracket to handle different broach lengths . . . . Puller brackets designed to handle 2 or more broaches . . . . Maximum platen rigidity with well-ribbed broach thrust bracket . . . . Platen removable for re-tooling . . . . Dual safety interlock mechanism . . . . Streamlined for appearance and strength . . . . Automatic lubrication of slide with its hardened and ground gibs . . . . Cylinders integral with both main and broach slides . . . . Plain or latch-type face plates . . . . Swinging locating fixtures with broach interlock available.

**colonial** BROACH COMPANY  
DETROIT 13, U.S.A.  
*Broaches Broaching Machines - Broaching Equipment*



# Classified Contents of This Number

## DESIGN, FIXTURE AND TOOL

Utilizing Rubber Dies in Hydraulic Presses.....	152
Progressive Die Principle Applied to Production Milling—By <i>Enoch Southall</i> .....	164
Combination Jig for Drilling and Shaping Plastic Part—By <i>James H. Rodgers</i> .....	187
Turret Tool for Turning Internal Spherical Surfaces—By <i>Edward Lay</i> .....	188
Bench Fixture for Under-Cutting Mica Insulation— By <i>G. F. Groschke</i> .....	189
Sharp-Angle Forming Tool—By <i>Martin H. Ball</i> ...	190

## INSPECTION AND GAGING

Precision Measurement of Balls for Instrument Bearings—By <i>W. H. Meiklejohn</i> .....	147
Checking Aircraft Assembling Jigs by Optical- Mechanical Means .....	171
Simple Gage for Checking Pump Gears— By <i>B. T. Smith</i> .....	177
Mechanism for Determining Wearing Qualities of Electronic Equipment—By <i>Edward Lay</i> .....	185
Measuring the Diameter of a Split Liner— By <i>Victor Swiatek</i> .....	186

## MANAGEMENT PROBLEMS

Individual Enterprise Alone Brings Prosperity and Employment .....	151
Preparing for Post-War Work without Interfering with the War Effort.....	165
Free Enterprise Necessary to Engineering Progress	165
A Definition of Free Enterprise.....	170
Principal Steps in Reconversion.....	181
To Create Jobs, Industry Must be Able to Invest..	184
New Materials and Methods Create New Applications .....	184
Pre-Reconversion Planning is of First Importance	191
War Production Must Continue at a High Level..	202
Value of Incentive System Proved by Lincoln Electric Co. ....	202
Courses in Production Supervision.....	202

## MATERIALS, METALS, AND ALLOYS

Glass that Resists Action of Hydrofluoric Acid...	192
Sealing Compound for Spot-Welded Joints.....	194
Hot Melt Dip Package for Metal Parts.....	194
Two Chromium Inoculants for Cast Iron.....	194
Heat-Resistant Lucite with Improved Properties..	194
"CarboRustex," a New Rust Solvent.....	195
Ferrous Blackening Process Provides Tough, Durable Finish .....	195
Colored Finishes for Zinc and Cadmium Surfaces	195
New Flame-Resistant Gaskets Replace Rubber...	200
Plastic Covering for Carbide-Tipped Tools.....	202
Solid Tungsten-Carbide Broaches .....	232

## MEETINGS AND NEWS OF SOCIETIES

Machine Shop Practice Discussed by Mechanical Engineers .....	166
War Production and Reconversion Problems Discussed by Manufacturers.....	168
Western Society of Engineers Celebrates Seventy- Fifth Anniversary .....	176
Automotive Engineers will Hold Annual Meeting in Detroit .....	196
Material-Handling Manufacturers Organize Trade Association .....	206

## MOTION PICTURES, EDUCATIONAL

Motion Pictures on Care of Ball Bearings.....	206
A Motion Picture to Help Foremen Solve Their Problems .....	234
Motion Picture of Gas Turbine Action.....	234

## NEWS OF INDUSTRY

Greenfield Tap & Die Purchases Geometric Tool Co. ....	167
Engineering News .....	182
News of the Industry.....	236

## SHOP PRACTICE

Negative-Rake Turning and Boring— By <i>George M. Jalma, Jr.</i> .....	135
Machine Equipped to Hob Internal Gears— By <i>L. Arico</i> and <i>J. Sullivan</i> .....	157
Broaching Applied in a Constantly Broadening Field—By <i>O. W. Bonnafé</i> .....	158
Plastic Coatings for Overseas Shipments.....	162
"Fiberglas" Insulation—A Most Versatile Material	163
Long Life of Rubber Belt.....	163
Preventing Accidents and Fires Caused by Oil- Soaked Floors .....	170
Anti-Friction Bearing Maintenance.....	170
An Unusual Job of Metal Spinning.....	192
Computing Angular Dimensions for a Cam Mill- ing Operation .....	193
Increasing the Life of Tools by Using the Right Cutting Fluid .....	200
Twisted Twist Drills Extensively Used by Ford..	200
Spring Rest Steadies Small Rods while Grinding.	204
Home-Made Hydraulic Press for Assembling Tires on Bogie Wheels.....	204
Shop Equipment News.....	208

## WELDING PRACTICE

A Spotlight as an Aid to Welders.....	176
Arc-Welding Metal-Cutting Tools to Save High- Speed Steel .....	178
Metal-Cutting Saw—An Example of Welded Frame Design .....	196
Water-Cooled Welding Fixture.....	206